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☐ 1. Document ID: US 6147494 A Relevance Rank: 99

L3: Entry 9 of 25 File: USPT Nov 14, 2000

US-PAT-NO: 6147494
DOCUMENT-IDENTIFIER: US 6147494 A

TITLE: Magnetic resonance apparatus provided with force-optimized gradient coils

DATE-ISSUED: November 14, 2000

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Ham; Cornelis L. G.	Eindhoven			NL

ASSIGNEE-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY	TYPE CODE
U.S. Philips Corporation	New York	NY			02

APPL-NO: 09/ 198934
DATE FILED: November 24, 1998

FOREIGN-APPL-PRIORITY-DATA:

COUNTRY	APPL-NO	APPL-DATE
EP	97203727	November 28, 1997

INT-CL: [07] G01 V 3/00

US-CL-ISSUED: 324/318; 324/319
US-CL-CURRENT: 324/318; 324/319

FIELD-OF-SEARCH: 324/318, 324/319, 324/320, 324/322, 324/300, 324/307, 324/309

PRIOR-ART-DISCLOSED:

U.S. PATENT DOCUMENTS

PAT-NO	ISSUE-DATE	PATENTEE-NAME	US-CL
4585995	April 1986	Flugan	324/322
5675255	October 1997	Sellers et al.	324/318
5742164	April 1998	Roemer et al.	324/318

ART-UNIT: 287

PRIMARY-EXAMINER: Arana; Louis

ABSTRACT:

The gradient coil system in a conventional MRI apparatus is optimized in respect of the shielding effect by the shielding coil of the system. Consequently, the system generally is not optimized in respect of the Lorentz forces occurring in the system, resulting in noise of a level such that it is annoying to the users. In order to avoid such noise, the system can be force-optimized. Because the shielding effect is partly lost in that case, however, eddy currents and hence disturbing noise would occur again. However, if the eddy currents are made to occur in acoustically insulated eddy current conductors which also have a large time constant for the decay of the eddy currents, the adverse effects of these eddy currents are adequately counteracted and the disturbing noise is reduced to an adequate extent. Particularly, the (cold) radiation shields of a cryogenic magnet system, arranged in vacuum, can be used as eddy current conductors. The vacuum then constitutes the acoustic insulation.

16 Claims, 15 Drawing figures

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments | Claims | KWIC | Draw Desc | Image

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2. Document ID: US 20020082496 A1 Relevance Rank: 98

L3: Entry 3 of 25 File: PGPB Jun 27, 2002

PGPUB-DOCUMENT-NUMBER: 20020082496
PGPUB-FILING-TYPE: new
DOCUMENT-IDENTIFIER: US 20020082496 A1

TITLE: Magnetic resonance apparatus with sound insulation

PUBLICATION-DATE: June 27, 2002

INVENTOR-INFORMATION:

NAME	CITY	STATE	COUNTRY	RULE-47
Kuth, Rainer	Herzogenaurach		DE	

US-CL-CURRENT: 600/410

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments | Claims | KWIC | Draw Desc | Image

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3. Document ID: DE 10049414 C2 DE 10049414 A1 US 20020082496 A1 JP 2002177242 A Relevance Rank: 85

L3: Entry 25 of 25 File: DWPI Sep 26, 2002

DERWENT-ACC-NO: 2002-445302
DERWENT-WEEK: 200265
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TITLE: Medical magnetic resonance imaging device, has additional sound insulation between the magnetic field gradient coils and the examination areas allowing higher current amplitudes to be used without patient discomfort

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments | Claims | KWIC | Draw Desc | Clip Img | Image

☐ 4. Document ID: US 6075363 A Relevance Rank: 78

L3: Entry 11 of 25 File: USPT Jun 13, 2000

US-PAT-NO: 6075363
DOCUMENT-IDENTIFIER: US 6075363 A

TITLE: Method for noise reduction in the operation of a gradient coil

DATE-ISSUED: June 13, 2000

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Sellers; Michael	Thakeham			GB
Boemmel; Franz	Erlangen			DE
Kaindl; Arthur	Erlangen			DE

ASSIGNEE-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY	TYPE CODE
Siemens Aktiengesellschaft	Munich			DE	03

APPL-NO: 09/ 129489
DATE FILED: August 4, 1998

FOREIGN-APPL-PRIORITY-DATA:

COUNTRY	APPL-NO	APPL-DATE
DE	197 33 742	August 4, 1997

INT-CL: [07] G01 V 3/00

US-CL-ISSUED: 324/318; 324/322
US-CL-CURRENT: 324/318; 324/322

FIELD-OF-SEARCH: 324/318, 324/319, 324/320, 324/321, 324/322, 324/300, 324/306, 324/307, 324/309

PRIOR-ART-DISCLOSED:

U.S. PATENT DOCUMENTS

PAT-NO	ISSUE-DATE	PATENTEE-NAME	US-CL
4954781	September 1990	Hirata	324/318
5084676	January 1992	Saho et al.	324/318
5235283	August 1993	Lehne et al.	324/318
5256969	October 1993	Miyajima et al.	324/318
5617026	April 1997	Yoshino et al.	324/318
5990680	November 1999	Mansfield	324/318

FOREIGN PATENT DOCUMENTS

FOREIGN-PAT-NO	PUBN-DATE	COUNTRY	US-CL
0 597 528	May 1994	EP	

OTHER PUBLICATIONS

Derwent Abstract for Japanese Application 08-231731.
Derwent Abstract for Japanese Application 02-169637.

ART-UNIT: 287

PRIMARY-EXAMINER: Arana; Louis

ABSTRACT:

In a method for noise reduction in the operation of a gradient coil of a magnetic resonance apparatus, at least a portion of the gradient coil is in contact with a reaction resin molding material. During operation of the gradient coil the reaction resin molding material is maintained at a temperature that is in the region of the glass transition temperature of the reaction resin molding material.

5 Claims, 5 Drawing figures

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments | KWIC
Draw Desc | Image

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5. Document ID: US 6043653 A Relevance Rank: 65

L3: Entry 12 of 25 File: USPT Mar 28, 2000

US-PAT-NO: 6043653
DOCUMENT-IDENTIFIER: US 6043653 A

TITLE: Magnetic resonance imaging system having mechanically decoupled field generators to reduce ambient acoustic noise

DATE-ISSUED: March 28, 2000

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Takamori; Hiromitu	Otawara			JP
Katsunuma; Ayumi	Otawara			JP
Uosaki; Yasuhiro	Nasu-Gun			JP
Toyoshima; Takeshi	Yokohama			JP
Iinuma; Kazuhiro	Nasu-Gun			JP
Kawamoto; Hiromi	Yaita			JP
Yamagata; Hitoshi	Otawara			JP

ASSIGNEE-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY	TYPE CODE
Kabushiki Kaisha Toshiba	Kawasaki			JP	03

APPL-NO: 08/ 951631
DATE FILED: October 16, 1997

FOREIGN-APPL-PRIORITY-DATA:

COUNTRY	APPL-NO	APPL-DATE
JP	8-274609	October 17, 1996

INT-CL: [07] G01 V 3/00

US-CL-ISSUED: 324/309; 324/318, 324/300

US-CL-CURRENT: 324/309; 324/300, 324/318

FIELD-OF-SEARCH: 324/318, 324/322, 324/309, 324/319, 324/300

PRIOR-ART-DISCLOSED:

U.S. PATENT DOCUMENTS

PAT-NO	ISSUE-DATE	PATENTEE-NAME	US-CL
5489848	February 1996	Furukawa	
5793210	August 1998	Pla et al.	324/318

FOREIGN PATENT DOCUMENTS

FOREIGN-PAT-NO	PUBN-DATE	COUNTRY	US-CL
59-174746	October 1984	JP	
63-246146	October 1988	JP	
2-147049	June 1990	JP	
3-268743	November 1991	JP	
6-189932	July 1994	JP	

ART-UNIT: 282

PRIMARY-EXAMINER: Oda; Christine K.

ASSISTANT-EXAMINER: Shrivastav; Brij B.

ABSTRACT:

Solid-borne vibrations and airborne vibrations from a gradient coil unit in an MRI gantry environment are markedly reduced thereby reducing ambient noise occurring due to the vibrations. Support assemblies retain the gradient coil unit in a mechanically-uncoupled or substantially-uncoupled state relative to the magnet by supporting the coil unit at separate positions on the floor (e.g., with anchor bolts rigidly coupling coil support assemblies to the floor). Moreover, the gradient coil unit and at least parts of the support assemblies may be retained in a vacuum space.

49 Claims, 14 Drawing figures

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments | KWIC
Draw Desc | Image

6. Document ID: US 6404200 B1 Relevance Rank: 64

L3: Entry 7 of 25 File: USPT Jun 11, 2002

US-PAT-NO: 6404200
DOCUMENT-IDENTIFIER: US 6404200 B1

TITLE: Magnetic resonance tomography apparatus with vacuum-insulated gradient coil system

DATE-ISSUED: June 11, 2002

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Dietz; Peter	Nuremberg			DE
Gebhardt; Matthias	Erlangen			DE
Renz; Wolfgang	Erlangen			DE

ASSIGNEE-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY	TYPE CODE
Siemens Aktiengesellschaft	Munich			DE	03

APPL-NO: 09/ 649497
DATE FILED: August 28, 2000

FOREIGN-APPL-PRIORITY-DATA:

COUNTRY	APPL-NO	APPL-DATE
DE	199 40 550	August 26, 1999

INT-CL: [07] G01 V 3/00

US-CL-ISSUED: 324/318; 324/307, 324/309
US-CL-CURRENT: 324/318; 324/307, 324/309

FIELD-OF-SEARCH: 324/318, 329/318, 329/309, 329/307

PRIOR-ART-DISCLOSED:

U.S. PATENT DOCUMENTS

PAT-NO	ISSUE-DATE	PATENTEE-NAME	US-CL
4652824	March 1987	Oppelt	
5489848	February 1996	Furukawa	
5617026	April 1997	Yoshino et al.	
5698980	December 1997	Sellers et al.	
5793210	August 1998	Pia et al.	
6157276	December 2000	Hedeen et al.	324/318

FOREIGN PATENT DOCUMENTS

FOREIGN-PAT-NO	PUBN-DATE	COUNTRY	US-CL
38 33 591	April 1990	DE	
0 138 269	April 1985	EP	

ART-UNIT: 2862

PRIMARY-EXAMINER: Lefkowitz; Edward

ASSISTANT-EXAMINER: Vargas; Dixomara

ABSTRACT:

A magnetic resonance tomography apparatus has a basic field magnet system and a gradient coil system. At least a part of a vacuum housing of an evacuatable space is thereby formed by at least a surface region of the basic field magnet system and by at least a surface region of the gradient coil system. Propagation of oscillations (vibrations) of the gradient coil system to the basic field magnet system via an intermediate layer between those surfaces of the gradient coil system and of the basic field magnet system that face each other is prevented by a vacuum in the evacuatable

space. In economical and space-saving fashion, the vacuum housing of the evacuatable space is formed to a large part by systems that are already needed for the operation of the apparatus.

16 Claims, 5 Drawing figures

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments | KWIC
Draw Desc | Image

7. Document ID: US 5793210 A Relevance Rank: 63

L3: Entry 14 of 25 File: USPT Aug 11, 1998

US-PAT-NO: 5793210
DOCUMENT-IDENTIFIER: US 5793210 A

TITLE: Low noise MRI scanner

DATE-ISSUED: August 11, 1998

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Pla; Frederic Ghislain	Clifton Park	NY		
Hedeen; Robert Arvin	Clifton Park	NY		
Dobberstein; Robert James	New Berlin	WI		
Ebben; Thomas Gerard	Sullivan	WI		
Mansell; Scott Thomas	Waterford	WI		
Obasih; Kemakolam Michael	Brookfield	WI		
Radziun; Michael James	Waterford	WI		
Sue; Peter Ping-Liang	Florence	SC		
Edelstein; William Alan	Schenectady	NY		

ASSIGNEE-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY	TYPE CODE
General Electric Company	Schenectady	NY			02

APPL-NO: 08/ 696077
DATE FILED: August 13, 1996

INT-CL: [06] G01 R 33/20

US-CL-ISSUED: 324/318
US-CL-CURRENT: 324/318

FIELD-OF-SEARCH: 324/300, 324/307, 324/309, 324/318

PRIOR-ART-DISCLOSED:

U.S. PATENT DOCUMENTS

PAT-NO	ISSUE-DATE	PATENTEE-NAME	US-CL
4602176	July 1986	Baker	
4680545	July 1987	Gray et al.	324/307
5084676	January 1992	Saho et al.	324/318
5179338	January 1993	Laskaris et al.	
5225782	July 1993	Laskaris et al.	
5278502	January 1994	Laskaris et al.	
5489848	February 1996	Furukawa	324/318

ART-UNIT: 221

PRIMARY-EXAMINER: O'Shea; Sandra L.

ASSISTANT-EXAMINER: Eisenberg; Michael

ABSTRACT:

A magnetic-resonance-imaging (MRI) scanner subassembly. In one subassembly, a preferably annularly-cylindrical-shaped enclosure contains a first vacuum, and an MRI gradient coil assembly is located within the enclosure in the first vacuum. Preferably, an annularly-cylindrical housing is included which is coaxially aligned with the enclosure and contains a second vacuum which is higher than the first vacuum, and an MRI superconductive main coil is located within the housing in the second vacuum. In another subassembly, an MRI gradient coil assembly has a threshold excitation frequency, and an isolation mount assemblage supports the MRI gradient coil assembly.

5 Claims, 2 Drawing figures

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments | KWIC
Draw Desc | Image

8. Document ID: US 5278502 A Relevance Rank: 62

L3: Entry 19 of 25 File: USPT Jan 11, 1994

US-PAT-NO: 5278502
DOCUMENT-IDENTIFIER: US 5278502 A

TITLE: Refrigerated superconducting MR magnet with integrated cryogenic gradient coils

DATE-ISSUED: January 11, 1994

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Laskaris; Evangelos T.	Schenectady	NY		
Dorri; Bizhan	Clifton Park	NY		
Vermilyea; Mark E.	Schenectady	NY		
Mueller; Otward M.	Ballston Lake	NY		

ASSIGNEE-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY	TYPE CODE
General Electric Company	Schenectady	NY			02

APPL-NO: 07/ 759387
DATE FILED: September 13, 1991

INT-CL: [05] G01V 3/00

US-CL-ISSUED: 324/318; 324/319
US-CL-CURRENT: 324/318; 324/319

FIELD-OF-SEARCH: 324/318, 324/319, 324/320, 335/216, 335/296, 335/297, 335/300

PRIOR-ART-DISCLOSED:

U.S. PATENT DOCUMENTS

PAT-NO	ISSUE-DATE	PATENTEE-NAME	US-CL
4646024	February 1987	Schenck et al.	324/318
4652824	March 1987	Oppelt	324/319
4737716	April 1988	Roemer et al.	324/319
4876510	October 1989	Siebold et al.	324/318
4924184	May 1990	Yoda	324/318
4924185	May 1990	Matsutani	324/319
4924198	May 1990	Laskaris	335/216

FOREIGN PATENT DOCUMENTS

FOREIGN-PAT-NO	PUBN-DATE	COUNTRY	US-CL
0433002	June 1991	EP	

ART-UNIT: 263

PRIMARY-EXAMINER: Arana; Louis

ABSTRACT:

This invention relates to refrigerated superconducting MR magnets having integrated cryogenic gradient coils. In particular, the amount of eddy currents produced by the magnet are substantially reduced while reducing the size and weight, and, therefore, the cost of the superconducting magnet required to produce an acceptable MR image.

15 Claims, 4 Drawing figures

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments | KWIC
Draw Desc | Image

☐ 9. Document ID: WO 9928757 A1 Relevance Rank: 62

L3: Entry 24 of 25 File: EPAB Jun 10, 1999

PUB-NO: WO009928757A1
DOCUMENT-IDENTIFIER: WO 9928757 A1
TITLE: MAGNETIC RESONANCE APPARATUS PROVIDED WITH FORCE-OPTIMIZED GRADIENT COILS

PUBN-DATE: June 10, 1999

INVENTOR-INFORMATION:

NAME	COUNTRY
HAM, CORNELIS LEONARDUS GERARDU	

ASSIGNEE-INFORMATION:

NAME	COUNTRY
KONINKL PHILIPS ELECTRONICS NV	NL
PHILIPS AB	SE

APPL-NO: IB09801683
APPL-DATE: October 22, 1998

PRIORITY-DATA: EP97203727A (November 28, 1997)

INT-CL (IPC): G01 R 33/385
EUR-CL (EPC): G01R033/385

ABSTRACT:

CHG DATE=19990803 STATUS=O>The gradient coil system in a conventional MRI apparatus is optimized in respect of the shielding effect by the shielding coil of the system. Consequently, the system generally is not optimized in respect of the Lorentz forces occurring in the system, resulting in noise of a level such that it is annoying to the users. In order to avoid such noise, the system can be force-optimized. Because the shielding effect is partly lost in that case, however, eddy currents and hence disturbing noise would occur again. However, if the eddy currents are made to occur in acoustically insulated eddy current conductors which also have a large time constant for the decay of the eddy currents, the adverse effects of these eddy currents are adequately counteracted and the disturbing noise is reduced to an adequate extent. Particularly, the (cold) radiation shields of a cryogenic magnet system, arranged in vacuum, can be used as eddy current conductors. The vacuum then constitutes the acoustic insulation.

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments | KWIC
Draw Desc | Image

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10. Document ID: US 5764059 A Relevance Rank: 58

L3: Entry 15 of 25 File: USPT Jun 9, 1998

US-PAT-NO: 5764059
DOCUMENT-IDENTIFIER: US 5764059 A

TITLE: Acoustic screen

DATE-ISSUED: June 9, 1998

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Mansfield; Peter	Bramcote			GB2
Bowtell; Richard William	Nottingham			GB2
Chapman; Barry Leonard Walter	Stapleford			GB2
Glover; Paul Martin	Chilwell			GB2

ASSIGNEE-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY	TYPE CODE
British Technology Group Limited	London			GB2	03

APPL-NO: 08/ 556941
DATE FILED: December 1, 1995

FOREIGN-APPL-PRIORITY-DATA:

COUNTRY	APPL-NO	APPL-DATE
GB	9311321	June 2, 1993

PCT-DATA:

APPL-NO	DATE-FILED	PUB-NO	PUB-DATE	371-DATE	102(E)-DATE
PCT/GB94/01187	June 1, 1994	WO94/28430	Dec 8, 1994	Dec 1, 1995	Dec 1, 1995

INT-CL: [06] G01 V 3/00

US-CL-ISSUED: 324/318; 324/319
US-CL-CURRENT: 324/318; 324/319

FIELD-OF-SEARCH: 324/318, 324/319, 324/322, 324/309, 324/314, 324/316, 335/296, 335/299, 128/653.5

PRIOR-ART-DISCLOSED:

U.S. PATENT DOCUMENTS

PAT-NO	ISSUE-DATE	PATENTEE-NAME	US-CL
4680545	July 1987	Gray et al.	324/307
4878024	October 1989	Overweg et al.	324/319
5018359	May 1991	Horikawa et al.	62/51.1
5084676	January 1992	Saho et al.	324/318
5198769	March 1993	Frese et al.	324/318
5235283	August 1993	Lehne et al.	324/318
5243286	September 1993	Rzedzian et al.	324/318
5345177	September 1994	Sato et al.	324/318
5554929	September 1996	Doty et al.	324/318
5572131	November 1996	Rzedzian	324/318

FOREIGN PATENT DOCUMENTS

FOREIGN-PAT-NO	PUBN-DATE	COUNTRY	US-CL
0 304 127	February 1989	EP	324/318
2704322	October 1994	FR	
4020593 A1	January 1991	DE	
41 41 514 A1	August 1992	DE	
91/19209	December 1991	WO	

OTHER PUBLICATIONS

Patent Abstract of Japan, vol. 14, No. 90 (C-691) (4033) 20 Feb. 1990.
Patent Abstract of Japan, vol. 16, No. 295 (C957) (5338) 30 Jun. 1992.

ART-UNIT: 225

PRIMARY-EXAMINER: Arana; Louis M.

ABSTRACT:

The invention describes apparatus for, and a method of, active acoustic screening and

combined active acoustic and magnetic screening, of magnetic field coils, which pass a time varying current and which reside in relatively high static magnetic fields, typically greater than about 0.1 T. The invention is particularly well suited for acoustic screening of magnetic field gradient coils used in Magnetic Resonance Imaging (MRI). In a preferred embodiment a closed loop carrying current is arranged such that two different parts of the loop are mechanically coupled, dimensioned and arranged with respect to one another such that Lorentz forces experienced by the magnetic equipment are substantially reduced and preferably cancelled.

In a different embodiment the invention is modified so as to permit simultaneous magnetic and acoustic screening.

The invention overcomes existing problems of non-acoustically screened coils used in conjunction with high magnetic fields, by by reducing vibrational forces by cancelling them, within the gradient coil structure, rather than damping or absorbing emitted high levels of acoustic noise.

17 Claims, 68 Drawing figures

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments | KWIC
Draw Desc | Image

☐ 11. Document ID: US 6107799 A Relevance Rank: 56

L3: Entry 10 of 25 File: USPT Aug 22, 2000

US-PAT-NO: 6107799
DOCUMENT-IDENTIFIER: US 6107799 A

TITLE: Noise reduction arrangement for a magnetic resonance tomography apparatus

DATE-ISSUED: August 22, 2000

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Sellers; Michael	Thakeham			GB
Schuster; Johann	Oberasbach			DE
Carlberger; Thomas	Sjuntrop			SE
Boemmel; Franz	Erlangen			DE
Hentzelt; Heinz	Erlangen			DE
Hartmann; Ludwig	Rieden			DE

ASSIGNEE-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY	TYPE CODE
Siemens Aktiengesellschaft	Munich			DE	03

APPL-NO: 09/ 083113
DATE FILED: May 22, 1998

FOREIGN-APPL-PRIORITY-DATA:

COUNTRY	APPL-NO	APPL-DATE
DE	197 22 481	May 28, 1997

INT-CL: [07] G01 V 3/00

US-CL-ISSUED: 324/318; 324/322
US-CL-CURRENT: 324/318; 324/322

FIELD-OF-SEARCH: 324/318, 324/319, 324/320, 324/321, 324/322, 324/300, 324/306, 324/307, 324/309

PRIOR-ART-DISCLOSED:

U.S. PATENT DOCUMENTS

PAT-NO	ISSUE-DATE	PATENTEE-NAME	US-CL
4639672	January 1987	Beaumont	324/318
5235283	August 1993	Lehne et al.	324/318
5256969	October 1993	Miyajima et al.	324/318
5331281	July 1994	Otsuka	324/318
5345177	September 1994	Sato et al.	324/318
5698980	December 1997	Sellers et al.	324/318
5793210	August 1998	Pla et al.	324/318

ART-UNIT: 282

PRIMARY-EXAMINER: Arana; Louis

ABSTRACT:

A nuclear magnetic resonance tomography apparatus has a magnet assembly with a first surface and a gradient coil assembly with a second surface, with an annular gap between these surfaces. A noise-reduction arrangement for damping the oscillations of the gradient coil assembly and/or for stiffening the gradient coil assembly is disposed in this gap in contact with the first and second surfaces. The noise-reducing arrangement can be composed of one or more components, and has contact surfaces, formed by one or more components, respectively in substantially surface-wide contact with the first and second surfaces of the tomography apparatus.

11 Claims, 4 Drawing figures

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments | KWIC
Draw Desc | Image

☐ 12. Document ID: US 20010022515 A1 Relevance Rank: 56

L3: Entry 5 of 25 File: PGPB Sep 20, 2001

PGPUB-DOCUMENT-NUMBER: 20010022515
PGPUB-FILING-TYPE: new
DOCUMENT-IDENTIFIER: US 20010022515 A1

TITLE: Magnetic resonance imaging apparatus

PUBLICATION-DATE: September 20, 2001

INVENTOR-INFORMATION:

NAME	CITY	STATE	COUNTRY	RULE-47
Yamashita, Masatoshi	Otawara-shi		JP	
Ishii, Manabu	Otawara-shi		JP	
Sakakura, Yoshitomo	Nasu-gun		JP	
Takamori, Hiromitsu	Otawara-shi		JP	
Nakabayashi, Kazuto	Nasu-gun		JP	
Hamamura, Yoshinori	Otawara-shi		JP	
Mitsui, Shinji	Nasu-gun		JP	
Yasuhara, Yasutake	Nasu-gun		JP	

US-CL-CURRENT: 324/300

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments | KWIC
Draw Desc | Image

13. Document ID: US 5394086 A   Relevance Rank: 56

L3: Entry 18 of 25   File: USPT   Feb 28, 1995

US-PAT-NO: 5394086
DOCUMENT-IDENTIFIER: US 5394086 A

TITLE: Feed cable system for coils in high magnetic fields

DATE-ISSUED: February 28, 1995

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Patrick; John L.	Chagrin Falls	OH		
Orlando; Paul T.	Mentor	OH		
Mastandrea; Nicholas J.	Bedford Heights	OH		

ASSIGNEE-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY	TYPE CODE
Picker International, Inc.	Highland Hts.	OH			02

APPL-NO: 08/ 104362
DATE FILED: August 9, 1993

INT-CL: [06] G01 V 3/00

US-CL-ISSUED: 324/318; 324/322
US-CL-CURRENT: 324/318; 324/322

FIELD-OF-SEARCH: 324/300, 324/307, 324/309, 324/311, 324/312, 324/313, 324/314, 324/318, 324/322, 128/653.5

PRIOR-ART-DISCLOSED:

U.S. PATENT DOCUMENTS

PAT-NO	ISSUE-DATE	PATENTEE-NAME	US-CL
4587493	May 1986	Sepponen	324/318
5036282	July 1991	Morich et al.	324/318
5185576	February 1993	Vavrek et al.	324/318
5235279	August 1993	Kaufman et al.	324/318
5311134	May 1994	Yamagata et al.	324/322

OTHER PUBLICATIONS

"Highly Linear Asymmetric Transverse Gradient Coil Design for Head Imaging", Myers, et al. SMRM Abstracts Aug. 1991, p. 711.

ART-UNIT: 267

PRIMARY-EXAMINER: Arana; Louis

ABSTRACT:

A toroidal vacuum dewer (22) holds a superconducting magnet assembly (10) which generates a substantially temporally constant magnetic field through a central bore (12). A whole body gradient coil (30) and a whole body RF coil assembly (32) are mounted to a cylindrical member (24) of the dewar. An insertable gradient coil assembly (40) is selectively insertable into and removable from the bore. The insertable gradient coil assembly includes gradient coils for selectively generating magnetic field gradients along three mutually orthogonal axes, e.g. x, y, and z-axes. A flexible cable (42) connects the insertable gradient coil with a series of current amplifiers (44). The current amplifiers selectively generate current pulses which are fed along feed conductors (84) of the coil assembly and which return along return conductors (86) of the cable. The feed and return conductors are configured such that the net feed and the net return current traverse the same effective path in opposite directions. Stated more mathematically,

.EPSILON.R.sub.i .times.(I.sub.i .times.B.sub.ext)=0

where R.sub.i is the distance of the i-th conductor from the common path, I.sub.i is the current carried by the i-th conductor, and B.sub.ext is the temporally constant magnetic field generated by the main magnetic field assembly. Because the net feed and return current pulses follow the same path, i.e. are coaxial, the net torque and the net force from the interaction between the current pulses and the temporally constant magnetic field are zero.

13 Claims, 8 Drawing figures

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments | KWIC
Draw Desc | Image

☐ 14. Document ID: US 4820988 A Relevance Rank: 56

L3: Entry 22 of 25 File: USPT Apr 11, 1989

US-PAT-NO: 4820988
DOCUMENT-IDENTIFIER: US 4820988 A

TITLE: Magnetic gradient coil set for nuclear magnetic resonance system having substantially different coil-patient spacings

DATE-ISSUED: April 11, 1989

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Crooks; Lawrence E.	Richmond	CA		
Carlson; Joseph W.	San Francisco	CA		

ASSIGNEE-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY	TYPE CODE
The Regents of the University of California	Berkeley	CA			02

APPL-NO: 07/ 105738
DATE FILED: October 7, 1987

INT-CL: [04] G01R 33/20

US-CL-ISSUED: 324/318; 324/322
US-CL-CURRENT: 324/318; 324/322

FIELD-OF-SEARCH: 324/318, 324/319, 324/320, 324/322, 324/309, 335/299, 335/300

PRIOR-ART-DISCLOSED:

U.S. PATENT DOCUMENTS

PAT-NO	ISSUE-DATE	PATENTEE-NAME	US-CL
3569823	March 1971	Golay	324/318
3622869	November 1971	Golay	324/318
4456881	June 1984	Compton	324/319
4642569	February 1987	Hayes et al.	324/318
4712067	December 1987	Roschmann et al.	324/318
4728895	March 1988	Briguet et al.	324/318

OTHER PUBLICATIONS

Magnetic Resonance in Medicine, 1, 44-65, (1984), "Magnet Field Profiling: Analysis and Correcting Coil Design" by Romeo and Hoult.

ART-UNIT: 265

PRIMARY-EXAMINER: Levy; Steward J.

ASSISTANT-EXAMINER: Arana; Louis M.

ABSTRACT:

In a gradient coil set for a magnetic resonance system, the y gradient coils are located substantially closer to the patient than are the x and z gradient coils. As a result, one may design the y gradient coils to produce a stronger y gradient, to have reduced inductance or otherwise better tailor the magnetic/electrical properties of the gradient coil set for MRI imaging sequences. In the exemplary embodiment, at least portions of the y gradient coils have a first spacing from the z-axis while the x and z gradient coils have a second substantially larger spacing from the z-axis. Furthermore, while the x and z gradient coils are centered about the z-axis in the patient access space, alternate sides of the y gradient coil set are centered about respectively off-set centers vertically displaced from the z-axis center of the patient access area. The result is a substantially rectangular or elliptical patient access opening with horizontal dimensions defined by the x, z coils sets and vertical dimensions defined by the y coil set.

23 Claims, 4 Drawing figures

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments | KWIC
Draw Desc | Image

15. Document ID: US 5530355 A Relevance Rank: 56

L3: Entry 17 of 25 File: USPT Jun 25, 1996

US-PAT-NO: 5530355
DOCUMENT-IDENTIFIER: US 5530355 A

TITLE: Solenoidal, octopolar, transverse gradient coils

DATE-ISSUED: June 25, 1996

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Doty; F. David	Columbia	SC		

ASSIGNEE-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY	TYPE CODE
Doty Scientific, Inc.	Columbia	SC			02

APPL-NO: 08/ 362598
DATE FILED: January 10, 1995

PCT-DATA:

APPL-NO	DATE-FILED	PUB-NO	PUB-DATE	371-DATE	102(E)-DATE
PCT/US93/04574	May 13, 1993	WO94/01785	Jan 20, 1994	Jan 10, 1995	Jan 10, 1995

INT-CL: [06] G01 V 3/14, H01 F 5/02, H01 F 27/28

US-CL-ISSUED: 324/318; 324/322, 335/299, 336/225
US-CL-CURRENT: 324/318; 324/322, 335/299, 336/225

FIELD-OF-SEARCH: 324/318, 324/322, 324/300, 335/299, 336/225

PRIOR-ART-DISCLOSED:

U.S. PATENT DOCUMENTS

PAT-NO	ISSUE-DATE	PATENTEE-NAME	US-CL
2354331	July 1944	Polydoroff	
2498475	February 1950	Adams	
3237090	February 1966	Royer et al.	
3466499	September 1969	Beth	
3569823	March 1971	Golay	
3671902	June 1972	Westendorp	
3789832	February 1974	Damadian	
3924211	December 1975	Ioffe et al.	
3932805	January 1976	Abe et al.	
4038622	July 1977	Purcell	335/216
4165479	August 1979	Mansfield	
4468622	August 1984	Frese et al.	
4514586	April 1985	Waggoner	
4595899	June 1986	Smith et al.	
4642569	February 1987	Hayes et al.	
4646024	February 1987	Schenck et al.	
4646046	February 1987	Vavrek et al.	
4707663	November 1987	Minkoff et al.	324/319
4733189	March 1988	Punchard et al.	
4737716	April 1988	Roemer et al.	
4766383	August 1988	Fox et al.	
4768008	August 1988	Purcell et al.	
4820988	April 1989	Crooks et al.	
4849696	July 1989	Brun et al.	
4849697	July 1989	Cline et al.	324/306
4876479	October 1989	Kawabata et al.	
4876510	October 1989	Siebold et al.	
4885540	December 1989	Snoddy et al.	324/318
4896129	January 1990	Turner et al.	
4910462	March 1990	Roemer et al.	
4920011	April 1990	Ogawa et al.	
4926125	May 1990	Roemer	
4935714	June 1990	Vermilyea	
4954781	September 1990	Hirata	
4965521	October 1990	Egloff	
4978920	December 1990	Mansfield et al.	
5036282	July 1991	Morich et al.	
5055789	October 1991	Kondo et al.	
5061891	October 1991	Totsuka et al.	
5072184	December 1991	Dickinson	
5084676	January 1992	Saho et al.	
5132621	July 1992	Kang et al.	
5166619	November 1992	Ries	
5185577	February 1993	Minemura	
5198769	March 1993	Frese et al.	
5225782	July 1993	Laskaris et al.	
5235283	August 1993	Lehne et al.	

FOREIGN PATENT DOCUMENTS

FOREIGN-PAT-NO	PUBN-DATE	COUNTRY	US-CL
304126	February 1989	EP	
586983	March 1994	EP	
4029477	April 1991	DE	
54-38792	March 1979	JP	
2050062	December 1980	GB	

OTHER PUBLICATIONS

E. C. Wong et al., Magnetic Resonance in Medicine, vol. 21, 1 Sep. 1991, pp. 39-48.
J. P. Boehmer et al., Journal of Magnetic Resonance, vol. 83, 1 Jun. 1989, pp. 152-159.

Y. Bangert and P. Mansfield, J. Physics E 15, "Magnetic Field Gradient Coils for NMR Imaging," 235-239 (1982).
P. Mansfield and B. Chapman, J. Magnetic Resonance 66, "Active Magnetic Screening of Gradient Coils in NMR Imaging," 573-576 (Feb. 1986).
P. Mansfield and B. Chapman, J. Magnetic Resonance 72, "Multinshield Active Magnetic Screening of Coil Structures in NMR," 211-233 (1987).
D. G. Taylor, R. Inamdar and M-C Bushell, Phys. Med. Biol. 33, "NMR Imaging in Theory and in Practice," 635-670 (1988).
B. H. Suits and D. E. Wilken, J. Physics E 22, "Improving Magnetic Field Gradient Coils for NMR Imaging," 565-573 (1989).
R. Hurwitz et al., Radiology 173, "Acoustic Analysis of Gradient-Coil Noise in MRI," 545-548 (1989).
J. J. Van Vaals and A. H. Bergman, J. Magnetic Resonance 90, "Optimization of Eddy-Current Compensation," 52-70 (1990).
M. K. Stehling, R. Turner, P. Mansfield, Science 254, "Echo-Planar Imaging: Magnetic Resonance Imaging in a Fraction of a Second," 43-49 (1991).
A. Jasinski et al., Magnetic Resonance in Medicine 24, "Shielded Gradient Coils and Radio Frequency Probes for High-Resolution Imaging of Rat Brains," 29-41 (1992).
P. Jehenson, M. Westphal, and N. Schuff, J. Magnetic Resonance 90, "Analytical Method for the Compensation of Eddy-Current Effects Induced by Pulsed Magnetic Field Gradients In NMR Systems" (1990) 264-278.

ART-UNIT: 225

PRIMARY-EXAMINER: O'Shea; Sandra L.

ASSISTANT-EXAMINER: Phillips; Roger

ABSTRACT:

A structure provides a gradient field useful in magnetic resonance imaging. Axially aligned, solenoidal-like coils are symmetrically distributed around the perimeter of the bore of a superconducting magnet in an MRI system so as to produce transverse gradients in the X and Y directions with exceptionally high efficiency and exceptionally low acoustic noise. Opposed solenoidal endcoils may be added to reduce axial flux leakage by generating an axial quadrupolar field. Radially aligned coils may be positioned near each end of the axial coils to reduce leakage flux by adding a transverse quadrupolar field to form a resulting octopolar field. Typically, the solenoid-like coils have a mean radius of about 15% of the radius of that of the imaging ellipsoidal region. A thick-walled stainless steel, copper and resin cylinder may be used to simplify gradient shielding problems. Silver plated bronze or stainless steel sheet is used as an rf shield.

43 Claims, 15 Drawing figures

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments | KWIC
Draw Desc | Image

☐ 16. Document ID: US 6469515 B2 Relevance Rank: 55

L3: Entry 6 of 25 File: USPT Oct 22, 2002

US-PAT-NO: 6469515
DOCUMENT-IDENTIFIER: US 6469515 B2

TITLE: Method for determining sources of interference

DATE-ISSUED: October 22, 2002

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Borsi; Hossein	Hannover			DE
Kaindl; Arthur	Erlangen			DE
Nowak; Stefan	Erlangen			DE

ASSIGNEE-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY	TYPE CODE
Siemens Aktiengesellschaft	Munich			DE	03

APPL-NO: 09/ 813435
DATE FILED: March 20, 2001

FOREIGN-APPL-PRIORITY-DATA:

COUNTRY	APPL-NO	APPL-DATE
DE	100 13 671	March 20, 2000

INT-CL: [07] G01 R 31/00, G01 R 31/08

US-CL-ISSUED: 324/536; 324/539
US-CL-CURRENT: 324/536; 324/539

FIELD-OF-SEARCH: 324/539, 324/127, 324/523, 324/528, 324/543, 324/532-536, 324/634, 324/654, 324/655

PRIOR-ART-DISCLOSED:

U.S. PATENT DOCUMENTS

PAT-NO	ISSUE-DATE	PATENTEE-NAME	US-CL
4887041	December 1989	Mashikian et al.	324/533
6161077	December 2000	Fawcett	324/523

FOREIGN PATENT DOCUMENTS

FOREIGN-PAT-NO	PUBN-DATE	COUNTRY	US-CL
197 08 585	May 1998	DE	
197 34 552	February 1999	DE	
198 02 551	August 1999	DE	

ART-UNIT: 2858

PRIMARY-EXAMINER: Le; N.

ASSISTANT-EXAMINER: He; Amy

ABSTRACT:

A method for determining sources of interference that cause partial discharges in an encapsulated conductor structure of a magnetic resonance apparatus, particularly in a gradient coil. Under the method, a low-frequency high voltage is applied to a conductor, and signals resulting from an adjacent high voltage are measured within a frequency range located in the kHz range, particularly from 40 to 400 kHz. The signals are analyzed in order to determine partial discharges. The conductor is again charged with a low-frequency high voltage and additional signals are measured within a frequency range located in the MHz range, particularly from 10 to 300 MHz. The additional signals are analyzed in order to determine partial discharges.

10 Claims, 7 Drawing figures

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments | KWIC
Draw. Desc | Image

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17. Document ID: US 20010048305 A1 Relevance Rank: 55

L3: Entry 4 of 25 File: PGPB Dec 6, 2001

PGPUB-DOCUMENT-NUMBER: 20010048305
PGPUB-FILING-TYPE: new
DOCUMENT-IDENTIFIER: US 20010048305 A1

TITLE: Method for determining sources of interference

PUBLICATION-DATE: December 6, 2001

INVENTOR-INFORMATION:

NAME	CITY	STATE	COUNTRY	RULE-47
Borsi, Hossein	Hannover		DE	
Kaindl, Arthur	Erlangen		DE	
Nowak, Stefan	Erlangen		DE	

US-CL-CURRENT: 324/322; 324/318, 455/232.1

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments | KWIC
Draw. Desc | Image

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18. Document ID: US 6157276 A Relevance Rank: 55

L3: Entry 8 of 25 File: USPT Dec 5, 2000

US-PAT-NO: 6157276
DOCUMENT-IDENTIFIER: US 6157276 A

TITLE: MRI magnet assembly with non-conductive inner wall

DATE-ISSUED: December 5, 2000

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Hedeen; Robert Arvin	Clifton Park	NY		
Edelstein; William Alan	Schenectady	NY		
El-Hamamsy; Sayed-Amr	Schenectady	NY		
Herd; Kenneth Gordon	Niskayuna	NY		
Ackermann; Robert Adolph	Schenectady	NY		

ASSIGNEE-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY	TYPE CODE
General Electric Company	Schenectady	NY			02

APPL-NO: 09/ 134764
DATE FILED: August 14, 1998

INT-CL: [07] H01 F 6/00

US-CL-ISSUED: 335/216; 324/318, 62/51.1, 505/879, 505/893, 505/898
US-CL-CURRENT: 335/216; 324/318, 505/879, 505/893, 505/898, 62/51.1

FIELD-OF-SEARCH: 335/216, 335/296, 324/318, 324/319, 324/320, 62/51.1, 505/879, 505/892, 505/893, 505/898

PRIOR-ART-DISCLOSED:

U.S. PATENT DOCUMENTS

PAT-NO	ISSUE-DATE	PATENTEE-NAME	US-CL
4492090	January 1985	Laskaris	62/55
4642569	February 1987	Hayes et al.	324/318
4771256	September 1988	Laskaris et al.	335/301
4879515	November 1989	Roemer et al.	324/318
4896128	January 1990	Wollan et al.	335/299
4910462	March 1990	Roemer et al.	324/318
4986078	January 1991	Laskaris	62/51.1
5001447	March 1991	Jayakumar	335/299
5034713	July 1991	Herd et al.	335/216
5278502	January 1994	Laskaris et al.	324/318
5489848	February 1996	Furukawa	324/318
5530413	June 1996	Minas et al.	335/216
5635839	June 1997	Srivastava et al.	324/320

ART-UNIT: 282

PRIMARY-EXAMINER: Barrera; Ray

ABSTRACT:

An MR magnet assembly includes a cylindrical vessel for housing a superconducting magnet and having a vacuum between its inner and outer walls. The vessel defines a magnet bore for receiving a patient to be imaged. A gradient coil assembly is mounted in the bore adjacent the inner wall of the magnet assembly. To reduce gradient coil noise, the inner wall is constructed of a non-conductive material which does not support eddy currents.

5 Claims, 5 Drawing figures

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments | KWIC
Draw. Desc | Image

☐ 19. Document ID: US 5554929 A Relevance Rank: 44

L3: Entry 16 of 25 File: USPT Sep 10, 1996

US-PAT-NO: 5554929
DOCUMENT-IDENTIFIER: US 5554929 A

TITLE: Crescent gradient coils

DATE-ISSUED: September 10, 1996

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Doty; F. David	Columbia	SC		
Wilcher; James K.	Columbia	SC		

ASSIGNEE-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY	TYPE CODE
Doty Scientific, Inc.	Columbia	SC			02

APPL-NO: 08/ 030853
DATE FILED: March 12, 1993

INT-CL: [06] G01 R 33/20

US-CL-ISSUED: 324/318
US-CL-CURRENT: 324/318

FIELD-OF-SEARCH: 324/300, 324/307, 324/309, 324/318, 324/319, 324/320, 324/322, 128/653.5

PRIOR-ART-DISCLOSED:

U.S. PATENT DOCUMENTS

PAT-NO	ISSUE-DATE	PATENTEE-NAME	US-CL
2354331	July 1944	Polydoroff	175/242
2498475	February 1950	Adams	324/318
3237090	February 1966	Royer et al.	323/45
3466499	September 1969	Beth	313/84
3569823	March 1971	Golay	324/300
3671902	June 1972	Westendorp	336/84
3924211	December 1975	Joffe et al.	335/284
4038622	July 1977	Purcell	335/216
4165479	August 1979	Mansfield	324/300
4514586	April 1985	Waggoner	174/35MS
4642569	February 1987	Hayes et al.	324/318
4646024	February 1987	Schenck et al.	324/318
4646046	February 1987	Vavrek et al.	335/301
4707663	November 1987	Minkoff et al.	324/319
4733189	March 1988	Punchard et al.	324/318
4737716	April 1988	Roemer et al.	324/319
4766383	August 1988	Fox et al.	324/318
4768008	August 1988	Purcell et al.	335/216
4820988	April 1989	Crooks et al.	324/318
4849697	July 1989	Cline et al.	324/306
4876510	October 1989	Siebold et al.	324/318
4885540	December 1989	Snoddy et al.	324/318
4910462	March 1990	Roemer et al.	324/318
4920011	April 1990	Ogawa et al.	428/596
4926125	May 1990	Roemer	324/318
4935714	June 1990	Vermilyea	335/299
4954781	September 1990	Hirata	324/318
4965521	October 1990	Egloff	324/312
4978920	December 1990	Mansfield	324/318
5036282	July 1991	Morich et al.	324/318
5061891	October 1991	Totsuka et al.	324/146
5084676	January 1992	Saho et al.	324/318
5132621	July 1992	Kang et al.	324/322
5166619	November 1992	Ries	324/318
5185577	February 1993	Minemura	324/318
5198769	March 1993	Frese et al.	324/318
5225782	July 1993	Laskaris et al.	324/318
5235283	August 1993	Lehne et al.	324/318

FOREIGN PATENT DOCUMENTS

FOREIGN-PAT-NO	PUBN-DATE	COUNTRY	US-CL
304126	February 1989	EP	
586983	March 1994	EP	
4029477	April 1991	DE	
54-38792	March 1979	JP	
2050062	December 1980	GB	

OTHER PUBLICATIONS

Y. Bangert and P. Mansfield, J. Physics E 15, "Magnetic Field Gradient Coils for NMR Imaging," 235 (1982).
P. Mansfield and B. Chapman, J. Magnetic Resonance 66, "Active Magnetic Screening of

Gradient Coils in NMR Imaging," 573-576 (Feb. 1986).
P. Mansfield and B. Chapman, J. Magnetic Resonance 72, "Multishield Active Magnetic Screening of Coil Structures in NMR," 211 (1987).
M. K. Stehling, R. Turner, P. Mansfield, Science 254, "Echo-Planar Imaging: Magnetic Resonance Imaging in a Fraction of a Second," 43 (1991).
E. C. Wong et al., Magnetic Resonance in Medicine, vol. 21, 1 Sep. 1991, pp. 39-48.
V. Bangert et al., Journal of Physics E. Scientific Instuments, vol. 15, 1 Feb. 1982, pp. 235-239.
J. P. Boehmer et al., Journal of Magnetic Resonance, vol. 83, 1 Jun. 1989, pp. 152-159.

ART-UNIT: 225

PRIMARY-EXAMINER: Strecker; Gerard R.

ASSISTANT-EXAMINER: Mah; Raymond Y.

ABSTRACT:

A high-conductivity ceramic coil form with an internal water jacket is used to simplify water cooling for 3-axis MRI gradient coil configurations on a single cylindrical coilform. Crescent-shaped, axially aligned coils are symmetrically employed on either side of the axial symmetry plane to increase transversely the region of field linearity. These crescent coils may be used in conjunction with Golay-type coils for improved switching efficiency. Lead-filled copper tubing may be used to reduce acoustic noise from pulsed coils in high external magnetic fields.

37 Claims, 16 Drawing figures

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20. Document ID: US 5179338 A Relevance Rank: 44

L3: Entry 20 of 25 File: USPT Jan 12, 1993

US-PAT-NO: 5179338
DOCUMENT-IDENTIFIER: US 5179338 A

TITLE: Refrigerated superconducting MR magnet with integrated gradient coils

DATE-ISSUED: January 12, 1993

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Laskaris; Evangelos T.	Schenectady	NY		
Roemer; Peter B.	Schenectady	NY		
Dorri; Bizhan	Clifton Park	NY		
Vermilyea; Mark E.	Schenectady	NY		

ASSIGNEE-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY	TYPE CODE
General Electric Company	Schenectady	NY			02

APPL-NO: 07/ 759337
DATE FILED: September 13, 1991

INT-CL: [05] G01V 3/00

US-CL-ISSUED: 324/318; 335/300
US-CL-CURRENT: 324/318; 335/300

FIELD-OF-SEARCH: 324/318, 324/319, 324/320, 335/299, 335/216, 335/301, 335/300

PRIOR-ART-DISCLOSED:

U.S. PATENT DOCUMENTS

PAT-NO	ISSUE-DATE	PATENTEE-NAME	US-CL
4646024	February 1987	Schenck et al.	324/318
4652824	March 1987	Oppelt	324/318
4737716	April 1988	Roemer et al.	324/319
4837541	June 1989	Pelc	335/301
4924198	May 1990	Laskaris	335/216
4983942	January 1991	Benesch	324/318

ART-UNIT: 263

PRIMARY-EXAMINER: Arana; Louis

ABSTRACT:

The invention relates to refrigerated superconducting MR magnets having integrated gradient coils. In particular, the amount of eddy currents produced by the magnet are substantially reduced while reducing the size and weight, and, therefore, the cost of the superconducting magnet required to produce an MR image.

14 Claims, 3 Drawing figures

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments | KWIC
Draw Desc | Image

☐ 21. Document ID: US 5886548 A Relevance Rank: 44

L3: Entry 13 of 25 File: USPT Mar 23, 1999

US-PAT-NO: 5886548
DOCUMENT-IDENTIFIER: US 5886548 A

TITLE: Crescent gradient coils

DATE-ISSUED: March 23, 1999

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Doty; F. David	Columbia	SC		
Wilcher; James K.	Columbia	SC		

ASSIGNEE-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY	TYPE CODE
Doty Scientific Inc.	Columbia	SC			02

APPL-NO: 08/ 608906
DATE FILED: February 29, 1996

PARENT-CASE:
This application is a divisional of application Ser. No. 08/030,853, filed on Mar. 12, 1993, now U.S. Pat. No. 5,554,929 incorporated herein by reference.

INT-CL: [06] G01 V 3/00

US-CL-ISSUED: 324/318
US-CL-CURRENT: 324/318

FIELD-OF-SEARCH: 324/318, 324/322, 335/299, 335/300, 335/301, 128/653.5

PRIOR-ART-DISCLOSED:

U.S. PATENT DOCUMENTS

PAT-NO	ISSUE-DATE	PATENTEE-NAME	US-CL
2354331	July 1944	Polydoroff	175/242
2498475	February 1950	Adams	324/318
3237090	February 1966	Royer et al.	323/45
3466499	September 1969	Beth	313/84
3569823	March 1971	Golay	324/300
3671902	June 1972	Westendorp	336/84
3924211	December 1975	Joffe et al.	335/284
4038622	July 1977	Purcell	335/216
4165479	August 1979	Mansfield	324/300
4514586	April 1985	Waggoner	175/35
4642569	February 1987	Hayes et al.	324/318
4646024	February 1987	Schenck et al.	324/318
4646046	February 1987	Vavrek et al.	335/301
4652824	March 1987	Oppelt	324/318
4707663	November 1987	Minkoff et al.	324/319
4733189	March 1988	Punchard et al.	324/318
4737716	April 1988	Roemer et al.	324/319
4766383	August 1988	Fox et al.	324/318
4768008	August 1988	Purcell et al.	335/318
4820988	April 1989	Crooks et al.	324/318
4849697	July 1989	Cline et al.	324/306
4876510	October 1989	Siebold et al.	324/318
4885440	December 1989	Snoddy et al.	324/318
4910462	March 1990	Roemer et al.	324/318
4920011	April 1990	Ogawa et al.	428/576
4926125	May 1990	Roemer	324/318
4935714	June 1990	Vermilyea	335/299
4954781	September 1990	Hirata	324/318
4965521	October 1990	Egloff	324/312
4978920	December 1990	Mansfield	324/318
5036282	July 1991	Morich et al.	324/318
5061891	October 1991	Totsuka et al.	324/146
5084676	January 1992	Saho et al.	324/318
5132618	July 1992	Sugimoto	324/318
5132621	July 1992	Kang et al.	324/322
5166619	November 1992	Ries	324/318
5185577	February 1993	Minemura	324/318
5198769	March 1993	Frese et al.	324/318
5225782	July 1993	Laskaris et al.	324/318

5225782	July 1993	Laskaris et al.	324/318
5235283	August 1993	Lehne et al.	324/318
5278502	January 1994	Laskaris et al.	324/318
5289128	February 1994	DeMeester et al.	324/318
5296810	March 1994	Morich	324/318
5349297	September 1994	DeMeester et al.	324/318
5406204	April 1995	Morich et al.	324/318
5424643	June 1995	Morich et al.	324/318
5489848	February 1996	Furukawa	324/318
5554929	September 1996	Doty et al.	324/318

FOREIGN PATENT DOCUMENTS

FOREIGN-PAT-NO	PUBN-DATE	COUNTRY	US-CL
304126	February 1989	EP	
586983	March 1994	EP	
4029477	April 1991	DE	
54-3879	February 1979	JP	
2050062	December 1980	GB	

OTHER PUBLICATIONS

E.C. Wong et al., Magnetic Resonance in Medicine, vol. 21, 1 Sep. 1991, pp. 39-48.
V. Bangert et al., Journal of Physics E: Scientific Instuments, vol. 15, 1 Feb. 1982, pp. 235-239.
J.P. Boehmer et al., Journal of Magnetic Resonance, vol. 83, 1 Jun. 1989, pp. 152-159.
Y. Bangert and P. Mansfield, J. Physics E 15, "Magnetic Field Gradient Coils for NMR Imaging," 235 (1982).
P. Mansfield and B. Chapman, J. Magnetic Resonance 66, "Active Magnetic Screening of Gradient Coils in NMR Imaging," 573-576 (Feb. 1986).
P. Mansfield and B. Chapman, J. Magnetic Resonance 72, "Multishield Active Magnetic Screening of Coil Structures in NMR," 211 (1987).
M.K. Stehling, R. Turner, P. Mansfield, Science 254, "Echo-Planar Imaging: Magnetic Resonance Imaging in a Fraction of a Second," 43 (1991).

ART-UNIT: 225

PRIMARY-EXAMINER: Arana; Louis M.

ABSTRACT:

A high-conductivity ceramic coil form with an internal water jacket is used to simplify water cooling for 3-axis MRI gradient coil configurations on a single cylindrical coilform. Crescent-shaped, axially aligned coils are symmetrically employed on either side of the axial symmetry plane to increase transversely the region of field linearity. These crescent coils may be used in conjunction with Golay-type coils for improved switching efficiency. Lead-filled copper tubing may be used to reduce acoustic noise from pulsed coils in high external magnetic fields.

13 Claims, 17 Drawing figures

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments | KWIC
Draw Desc | Image

☐ 22. Document ID: US 20020148604 A1 Relevance Rank: 43

L3: Entry 1 of 25 File: PGPB Oct 17, 2002

PGPUB-DOCUMENT-NUMBER: 20020148604
PGPUB-FILING-TYPE: new
DOCUMENT-IDENTIFIER: US 20020148604 A1

TITLE: Method and system to regulate cooling of a medical imaging device

PUBLICATION-DATE: October 17, 2002

INVENTOR-INFORMATION:

NAME	CITY	STATE	COUNTRY	RULE-47
Emeric, Pierre R.	Milwaukee	WI	US	
Hedlund, Carl R.	Waterford	NY	US	

US-CL-CURRENT: 165/206

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments | KWIC
Draw Desc | Image

23. Document ID: US 5084676 A Relevance Rank: 37

L3: Entry 21 of 25 File: USPT Jan 28, 1992

US-PAT-NO: 5084676
DOCUMENT-IDENTIFIER: US 5084676 A

TITLE: Nuclear magnetic resonance apparatus

DATE-ISSUED: January 28, 1992

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Saho; Norihide	Tsuchiura			JP
Yamamoto; Shinji	Katuta			JP
Shudo; Tuyosi	Katsuta			JP
Otsuka; Masayuki	Katsuta			JP
Hirata; Tohsuke	Ibaraki			JP
Kikuchi; Katsuaki	Tsuchiura			JP
Shimode; Shinichi	Ibaraki			JP
Nemoto; Takeo	Ibaraki			JP

ASSIGNEE-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY	TYPE CODE
Hitachi, Ltd.	Tokyo			JP	03

APPL-NO: 07/ 454262
DATE FILED: December 21, 1989

FOREIGN-APPL-PRIORITY-DATA:

COUNTRY	APPL-NO	APPL-DATE
JP	63-323353	December 23, 1988
JP	1-166692	June 30, 1989

INT-CL: [05] G01R 33/20

US-CL-ISSUED: 324/318; 324/322
US-CL-CURRENT: 324/318; 324/322

FIELD-OF-SEARCH: 324/300, 324/307, 324/309, 324/318, 324/319, 324/322, 128/653A, 335/219, 335/216, 335/299, 335/300, 336/199, 336/208, 336/225

PRIOR-ART-DISCLOSED:

U.S. PATENT DOCUMENTS

PAT-NO	ISSUE-DATE	PATENTEE-NAME	US-CL
4636729	January 1987	Maurer	324/318
4639672	January 1987	Beaumont	324/318
4954781	September 1990	Hirata	324/300

ART-UNIT: 265

PRIMARY-EXAMINER: Tokar; Michael J.

ABSTRACT:

A nuclear magnetic resonance apparatus in accordance with the present invention includes ferro-magnetic field generation means and gradient field generation means and fixes the gradient field generation means at a predetermined position inside a cylindrical space by a support member. An elastic member is interposed between the support member and the gradient field generation means, and means for improving rigidity of the gradient field generation means, such as another support member and a fastening jig of the gradient field generation means, is disposed and fixed to the elastic member described above. In the manner image quality can be improved and noise can be reduced.

20 Claims, 21 Drawing figures

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments | KWIC
Draw Desc | Image

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24. Document ID: US 20020118015 A1 Relevance Rank: 34

L3: Entry 2 of 25 File: PGPB Aug 29, 2002

PGPUB-DOCUMENT-NUMBER: 20020118015
PGPUB-FILING-TYPE: new
DOCUMENT-IDENTIFIER: US 20020118015 A1

TITLE: Medical examination apparatus provided with at least one magnet

PUBLICATION-DATE: August 29, 2002

INVENTOR-INFORMATION:

NAME	CITY	STATE	COUNTRY	RULE-47
Ham, Cornelis Leonardus Gerardus	Eindhoven		NL	

US-CL-CURRENT: 324/318; 324/319

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments | KWIC
Draw Desc | Image

25. Document ID: US 4652824 A Relevance Rank: 34

L3: Entry 23 of 25 File: USPT Mar 24, 1987

US-PAT-NO: 4652824
DOCUMENT-IDENTIFIER: US 4652824 A

TITLE: System for generating images and spacially resolved spectra of an examination subject with nuclear magnetic resonance

DATE-ISSUED: March 24, 1987

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Oppelt; Arnulf	Erlangen			DE

ASSIGNEE-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY	TYPE CODE
Siemens Aktiengesellschaft	Berlin and Munich			DE	03

APPL-NO: 06/ 586049
DATE FILED: March 5, 1984

FOREIGN-APPL-PRIORITY-DATA:

COUNTRY	APPL-NO	APPL-DATE
DE	3310160	March 21, 1983

INT-CL: [04] G01R 33/20, H01F 7/22, F17C 1/00

US-CL-ISSUED: 324/318; 324/319, 335/216, 62/514R
US-CL-CURRENT: 324/318; 324/319, 335/216, 335/299, 505/844, 62/48.3, 62/51.1

FIELD-OF-SEARCH: 324/309, 324/315, 324/318, 324/319, 324/320, 324/322, 335/296, 335/300, 335/301, 335/316, 335/216, 335/299, 62/514R

PRIOR-ART-DISCLOSED:

U.S. PATENT DOCUMENTS

PAT-NO	ISSUE-DATE	PATENTEE-NAME	US-CL
3173079	March 1965	McFee	335/216
3336526	August 1967	Weaver, Jr. et al.	324/319
4291541	September 1981	Kneip, Jr. et al.	62/514R X
4315216	February 1982	Clow	324/309
4442404	April 1984	Bergmann	324/309
4467303	August 1984	Laskaris	335/216
4520315	May 1985	Loeffler	324/309

OTHER PUBLICATIONS

Kaufman et al., Hardware for NMR Imaging, Nuclear Magnetic Resonance Imaging in Medicine, 1981, pp. 53-63.
Conference: Proceedings of the 10th International Conference on Low Temperature Physics Otenaimi, Finland (Aug. 14-20, 1975), pp. 286-288 by J. D. Wilde.
Kaufman, Nuclear Magnetic Resonance Imaging in Medicine, 1981, pp. 53-63.

ART-UNIT: 265

PRIMARY-EXAMINER: Levy; Stewart J.

ASSISTANT-EXAMINER: Oldham; Scott M.

ABSTRACT:

For providing nuclear magnetic resonance equipment with reduced noise generation, gradient coils are disposed in the vacuum of the cryostat which accepts the superconducting magnetic coils for generating the fundamental field. Under given conditions, the radio-frequency transmission and reception coils or antennae are also located in the vacuum.

5 Claims, 4 Drawing figures

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Term	Documents
SOUND.DWPI,TDBD,EPAB,JPAB,USPT,PGPB.	360358
SOUNDS.DWPI,TDBD,EPAB,JPAB,USPT,PGPB.	56032
ACOUSTIC$4	0
ACOUSTIC.DWPI,TDBD,EPAB,JPAB,USPT,PGPB.	153128
ACOUSTICA.DWPI,TDBD,EPAB,JPAB,USPT,PGPB.	52
ACOUSTICAAL.DWPI,TDBD,EPAB,JPAB,USPT,PGPB.	1
ACOUSTICAALY.DWPI,TDBD,EPAB,JPAB,USPT,PGPB.	1
ACOUSTICAILY.DWPI,TDBD,EPAB,JPAB,USPT,PGPB.	1
ACOUSTICAL.DWPI,TDBD,EPAB,JPAB,USPT,PGPB.	21728
ACOUSTICALL.DWPI,TDBD,EPAB,JPAB,USPT,PGPB.	4
(L2 AND (SOUND OR ACOUSTIC$4)).USPT,PGPB,JPAB,EPAB,DWPI,TDBD.	25

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L3: Entry 25 of 25 File: DWPI Sep 26, 2002

DERWENT-ACC-NO: 2002-445302
DERWENT-WEEK: 200265

TITLE: Medical magnetic resonance imaging device, has additional sound insulation between the magnetic field gradient coils and the examination areas allowing higher current amplitudes to be used without patient discomfort

Basic Abstract Text (1):
NOVELTY - Magnetic resonance device has a first component group with a base magnetic field system (12) and a gradient coil system (14). A second component group has an examination area (24) for receipt of a patient (50). Between the two component groups a sound insulation layer is placed forming two spaces (10, 20) that are isolated, in terms of sound, from each other.

Basic Abstract Text (2):
USE - Nuclear magnetic resonance device for patient examination with sound insulation provided so that the gradient coils can be operated at high currents.

Basic Abstract Text (3):
ADVANTAGE - To improve image quality and shorten examination times, higher current amplitudes are used in the gradient coils. The resulting noise is effectively insulated so that patients are not subjected to uncomfortable or intolerable noise levels.

Basic Abstract Text (4):
DESCRIPTION OF DRAWING(S) - Figure shows a section through a magnetic resonance imaging arrangement.

Basic Abstract Text (9):
sound isolated areas. 10, 20

Equivalent Abstract Text (1):
NOVELTY - Magnetic resonance device has a first component group with a base magnetic field system (12) and a gradient coil system (14). A second component group has an examination area (24) for receipt of a patient (50). Between the two component groups a sound insulation layer is placed forming two spaces (10, 20) that are isolated, in terms of sound, from each other.

Equivalent Abstract Text (2):
USE - Nuclear magnetic resonance device for patient examination with sound insulation provided so that the gradient coils can be operated at high currents.

Equivalent Abstract Text (3):
ADVANTAGE - To improve image quality and shorten examination times, higher current amplitudes are used in the gradient coils. The resulting noise is effectively insulated so that patients are not subjected to uncomfortable or intolerable noise levels.

Equivalent Abstract Text (4):
DESCRIPTION OF DRAWING(S) - Figure shows a section through a magnetic resonance imaging arrangement.

Equivalent Abstract Text (9):
sound isolated areas. 10, 20

Standard Title Terms (1):
MEDICAL MAGNETIC RESONANCE IMAGE DEVICE ADD SOUND INSULATE MAGNETIC FIELD GRADIENT COIL

EXAMINATION AREA ALLOW HIGH CURRENT AMPLITUDE PATIENT DISCOMFORT

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L3: Entry 11 of 25 File: USPT Jun 13, 2000

DOCUMENT-IDENTIFIER: US 6075363 A
TITLE: Method for noise reduction in the operation of a gradient coil

Abstract Text (1):
In a method for noise reduction in the operation of a gradient coil of a magnetic resonance apparatus, at least a portion of the gradient coil is in contact with a reaction resin molding material. During operation of the gradient coil the reaction resin molding material is maintained at a temperature that is in the region of the glass transition temperature of the reaction resin molding material.

Brief Summary Text (3):
The present invention relates to a method for noise reduction in the operation of a gradient coil of a magnetic resonance apparatus, wherein at least a portion of the gradient coil is in contact with a reaction resin molding material.

Brief Summary Text (5):
In diagnostic magnetic resonance tomography apparatuses, considerable disturbing noise arises due to structural oscillations which occur due to the operation of the apparatus with controlled gradient coils. The noise level can exceed 120 dB.

Brief Summary Text (6):
For noise reduction, both passive and active measures are used. One passive noise reduction technique is to increase the rigidity of the gradient coil, as is known from German OS 41 41 514. The intrinsic oscillation behavior of the gradient coil system is thereby matched to smaller oscillation amplitudes and to higher frequencies, so that an effective damping can then be achieved using sound insulation measures.

Brief Summary Text (7):
German OS 41 41 514, as a further passive measure for reduction of disturbing noise, discloses connecting a casting resin molding compound with the gradient coils, which compound also achieves a good sound damping at the operating temperature of the gradient coil system, in addition to having a high modulus of elasticity. Due to the intensive cross-linking among one another of the macromolecules of the resin, a duroplast molding material can never simultaneously exhibit a high modulus of elasticity and a good inner mechanical damping.

Brief Summary Text (8):
As a further passive measure for noise reduction, it is known to build a hole structure into the gradient coil.

Brief Summary Text (9):
In European Application 0 507 528, an active measure for noise reduction is described employing the production of counter-sound via loudspeakers. In this way, noise at the ear of the patient is reduced.

Brief Summary Text (10):
A further measure for noise reduction in gradient coils is disclosed in U.S. Pat. No 4,954,781, which teaches arranging a sandwich structure between the patient to be examined and the main magnet. The sandwich structure includes a visco-elastic layer pressed by two parts.

Brief Summary Text (14):
An object of the present invention is to provide a method for noise reduction in the operation of a gradient coil of a magnetic resonance apparatus with which a further mechanical damping of the disturbing sound is possible.

Brief Summary Text (15):
The object is achieved in a method wherein during the operation of the gradient coil, the reaction resin molding material is held at a temperature that is in the region of the glass transition temperature of the reaction resin molding material. With this method, it is possible to increase the damping of the gradient coil, without having to use additional materials and/or expenses. The method exploits the fact that the loss factor that determines the mechanical damping increases by an order of magnitude in the region of the glass transition temperature. The inner damping curve of the reaction resin molding material passes through a maximum at the glass transition temperature.

Brief Summary Text (16):
In an embodiment of the method for noise reduction, during the operation of the gradient coil cooling takes place in such a way that the temperature of the reaction resin molding material is in the region of the glass transition temperature. Noise reduction can thereby be achieved only by means of a modification of the cooling system connected with the gradient coil.

Drawing Description Text (5):
FIG. 4 shows a schematic diagram of a gradient system of a diagnostic magnetic resonance apparatus, whose operating temperature is maintained in the region of the glass transition temperature.

Detailed Description Text (10):
FIG. 4 shows a schematic representation of a sectional view of a diagnostic magnetic resonance apparatus, with the components that are relevant for noise production and noise reduction. Inside a radio-frequency shielding chamber 20 are arranged the components of the diagnostic magnetic resonance apparatus constructed for the reception of a patient. These components include a superconducting magnet 22, for the production of a static and homogenous magnetic field inside a cylindrical examination chamber 24. The direction of the magnetic field in the examination chamber proceeds parallel to the axis of symmetry 26. For the local resolution of the magnetic resonance signals, a gradient coil system 28 is required, which produces gradient magnetic fields that can vary chronologically and which are superposed on the main magnetic field in three spatial directions perpendicular to one another. The gradient system 28 is of conventional tube-shaped construction, as described for example in German OS 41 41 514, described above, and is immediately adjacent, in the inner chamber 24, to the basic field magnet 22. The coils belonging to the gradient system 28 are at least partially embedded in a reaction resin molding material, in particular an epoxy resin molding material. In addition, at the examination chamber 24 a radio-frequency system 30 is connected to the gradient system 28, for the excitation and reception of magnetic resonance signals. The chronologically variable gradient streams, which are in the kHz region, are produced by a gradient current supply 32 connected to the gradient coils. The current curves are predetermined by a control computer (not shown).

Detailed Description Text (11):
The currents flowing in the gradient coils produce a considerable heat emission, carried away via a water-cooling system 34. The water cooling system 34 includes cooling ducts that are embedded in the epoxy resin molding material and that are connected to an external cooling unit 37 via cooling lines 36. At suitable locations, one or more temperature sensors 38 are embedded in the epoxy resin molding material, which measure the temperature of the epoxy resin molding material and emit signals to a controller 40. As a target value, the glass transition temperature T.sub.g of the epoxy resin molding material is supplied to the controller 40. The controller 40 is first placed in an operational connection with the gradient current supply 32, in order to heat the gradient system 28 to the glass transition temperature T.sub.g before the examination operation of the magnetic resonance apparatus. During operation, the controller 40 is in operational connection with the cooling system 34, in order to adjust the cooling in such a way that the operating temperature is maintained at the glass transition temperature T.sub.g.

CLAIMS:

1. A method for noise reduction in the operation of a gradient coil of a magnetic resonance system comprising the steps of:

placing at least a portion of a gradient coil in contact with a reaction resin molding material having a glass transition temperature region associated therewith; and

during operation of said gradient coil, maintaining said reaction resin molding material at a temperature within said glass transition temperature range of said reaction resin molding material.

2. A method as claimed in claim 1 wherein the operation of said gradient coil produces heat, and wherein the step of maintaining said reaction resin molding material at a temperature within the glass transition temperature region of said reaction resin molding material comprises cooling said reaction resin molding material with a cooling system during operation of said gradient coil.

3. A method as claimed in claim 2 wherein the step of cooling said reaction resin molding material during operation of said gradient coil comprises circulating water through said cooling system during operation of said gradient coil.

5. A method as claimed in claim 4 wherein said gradient coil is operated by a gradient current supply, and wherein the step of heating said reaction resin molding material to a temperature within said glass transition temperature region comprises heating said reaction resin molding material using said gradient current supply.

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L3: Entry 12 of 25 File: USPT Mar 28, 2000

DOCUMENT-IDENTIFIER: US 6043653 A
TITLE: Magnetic resonance imaging system having mechanically decoupled field generators to reduce ambient acoustic noise

Abstract Text (1):
Solid-borne vibrations and airborne vibrations from a gradient coil unit in an MRI gantry environment are markedly reduced thereby reducing ambient noise occurring due to the vibrations. Support assemblies retain the gradient coil unit in a mechanically-uncoupled or substantially-uncoupled state relative to the magnet by supporting the coil unit at separate positions on the floor (e.g., with anchor bolts rigidly coupling coil support assemblies to the floor). Moreover, the gradient coil unit and at least parts of the support assemblies may be retained in a vacuum space.

Brief Summary Text (3):
The prevent invention relates to a magnetic resonance imaging (MRI) system for medical diagnosis and a noise insulating method to be implemented in the system. More particularly, this invention is concerned with greatly suppressing noises derived from the pulsating drive of a gradient coil unit and with a noise insulating method to be implemented in the MRI system.

Brief Summary Text (5):
A magnetic resonance imaging system for medical diagnosis is an imaging system utilizing a magnetic resonance phenomenon exhibited by nuclear spins in a subject body. The magnetic resonance imaging system is non-invasive and can produce images of the inside of a subject in the absence of exposure to X rays. The usefulness of the magnetic resonance imaging system even in clinical practice has been proven.

Brief Summary Text (6):
In general, a magnetic resonance imaging system for producing MR images comprises a gantry having a diagnostic space in which a subject is inserted and positioned, and a main unit interlocked with the gantry. The gantry is provided with various components, e.g., a magnet for generating a static magnetic field in the diagnostic space, such as, a superconducting magnet, a gradient coil unit for generating linear magnetic field gradients to be supposed on the static magnetic field, and a radio-frequency (RF) coil for transmitting a radio-frequency signal and receiving an MR signal are indispensable. For scanning, the magnet, gradient coil unit, and RF coil are driven according to a desired pulse sequence. Namely, linear magnetic field gradients changing in strength in x-axis, y-axis, and z-axis directions are superposed on a subject lying in the static magnetic field. Nuclear spins in the subject are excited magnetically by a radio-frequency signal at the Larmor frequency. A magnetic resonance (MR) signal produced by the excitation is detected. For example, a two-dimensional tomographic image of the subject is reconstructed on the basis of the signal.

Brief Summary Text (7):
In the above magnetic resonance imaging, the need to speed up imaging (i.e., to shorten the time required for imaging has increased in recent years. For coping with the need, an imaging technique using a pulse sequence including a gradient pulse to be switched (reversed) at a high speed; such as, fast echo planar imaging (EPI) has been developed. Some of these techniques have successfully been put to practical use. When a gradient pulse is generated, an electromagnetic force works on a gradient coil unit at the rise or reversal of the gradient pulse at audio frequencies. The electromagnetic force mechanically distorts the coil unit. This causes the whole unit to vibrate. There is a problem that acoustic vibrations occur with vibrations made by the coil unit and consequently loud acoustic noises occur. In particular, when a gradient pulse is reversed at high speed, a vibrations caused by application of the pulse are

intensified. From this viewpoint, as imaging is speeded up, induced acoustic noises are intensified. The noises may give a subject (patient) lying down in the diagnostic space of the gantry a great sense of discomfort or unease.

Brief Summary Text (8):
Several proposals have been made in an effort to eliminate such noises in the past. As described in, for example. Japanese Unexamined Patent Publication Nos. 59-174746, 63-246146, 3-268743, and 6-189932 (hereinafter, the first to fourth prior arts), the whole unit of gradient coils in sealed in a vacuum container in order to discontinue acoustic propagation of vibrations or noises by utilizing a vacuum space.

Brief Summary Text (10):
The first to fourth prior arts have proposed a structure in which a gradient coil unit is merely enclosed with a vacuum space. A container and covers defining the vacuum space are mechanically connected to the cover and housing of a magnet for generating a static magnetic field, and the gradient coil unit itself is supported by the container and cover of the magnet for generating a static magnetic field. Part of the vibrations (noises) stemming from the gradient coil unit is cut off by the vacuum space but another part of the vibrations propagates along supporting units for supporting the gradient coil unit and reaches the magnet for generating a static magnetic field. The magnet for generating a static magnetic field thus also vibrates due to the vibrations made by the gradient coil unit. This poses a problem in that the whole of a gantry then serves as a source of acoustic vibrations to cause loud noises. That is to say, the known measures of enclosing the gradient coil unit within a vacuum are imperfect for suppressing noises.

Brief Summary Text (12):
The present invention attempts to solve these unsolved problems. The first object of the present invention is to successfully suppress noises (vibrations) from the whole gantry by markedly reducing solid-borne vibrations steaming from a gradient coil unit when a magnetic resonance imaging system is driven.

Brief Summary Text (13):
The second object of the present invention is to provide a less noisy magnetic resonance imaging system in which noises (vibrations) in the whole gantry are suppressed to a very low level by markedly reducing solid-borne vibrations stemming from a gradient coil unit when the magnetic resonance imaging system is driven and by cutting off airborne vibrations stemming from the gradient coil unit at the same time.

Brief Summary Text (14):
For accomplishing the above objects, according to the first aspect of the present invention, a magnetic resonance imaging system has a gantry including static field generating means for generating a static magnetic field in a scanning area in a diagnostic space, gradient generating means for generating magnetic field gradients in the scanning area, supporting means for retaining the gradient generating means in a mechanically uncoupled or substantially uncoupled state relative to the static field generating means and supporting the gradient generating means above an installation place, and vacuum space creating means for defining a closed space around at least the gradient generating means and bringing the closed space to a vacuum state. The magnetic resonance imaging system is characterized in that noises derived from drive of the gradient generating means are suppressed.

Brief Summary Text (15):
Aerial propagation of vibrations stemming from a gradient coil unit serving as the gradient generating means is blocked by the surrounding vacuum space. Moreover, solid propagation of the vibrations to a magnet serving as the static field generating means or any other component is suppressed. Noises (vibrations) occurring in the gantry are therefore reduced markedly.

Brief Summary Text (16):
Preferably, coupling means for rigidly coupling the supporting means to the installation place is included. Owing to the inclusion of the coupling means, vibrations stemming from the gradient coil unit serving as the gradient generating means are transmitted reliably to the floor that is the installation place via the supporting means. As a result, a mass effect exerted by the floor can be utilized effectively. The floor attenuates propagated vibrations. Noises are therefore minimized more reliably.

Brief Summary Text (17):

According to the second aspect of the present invention, a magnetic resonance imaging system has a gantry including static field generating means for generating a static magnetic field in a scanning area in a diagnostic space, first supporting means for supporting the static field generating means while resting at a position on an installation place, gradient generating means for generating magnetic field gradients in the scanning area, second supporting means for retaining the gradient generating means in a mechanically uncoupled or substantially uncoupled state relative to the generating means and supporting the magnetic field gradient generating means while resting at a position different from the position on the installation place, and coupling means for rigidly coupling the gradient supporting means to the installation place. The magnetic resonance imaging system in characterized in that noises derived from drive of the gradient generating means are suppressed.

Brief Summary Text (18):
Preferably, the static field generating means is a magnet, and the gradient generating means is a gradient coil unit composed of x gradient coils, y gradient coils, and z gradient coils. For example, the coupling means is setscrews for rigidly coupling the supporting means to the rigid floor that is the installation place.

Brief Summary Text (19):
In the magnetic resonance imaging system according to the second aspect, the gradient coil unit and magnet are supported mechanically separately by the static field and gradient supporting means. Vibrations made by the gradient coils are propagated to the floor via the coupling means and absorbed owing to a mass effect exerted by the floor. As a result, the vibrations of the gradient coil unit are actively attenuated. Moreover, the propagation of the vibrations to the magnet is suppressed, Consequently, noises in the whole gantry can be reduced.

Drawing Description Text (3):
FIG. 1 is a partly-perspective front view showing the structure of a gantry of a magnetic resonance imaging system in accordance with the first embodiment of the present invention;

Drawing Description Text (6):
FIG. 4 is a partly-perspective front view showing the structure of a gantry of a magnetic resonance imaging system in accordance with the second embodiment of the present invention;

Drawing Description Text (8):
FIG. 6 is a partly-perspective front view showing the structure of a gantry of a magnetic resonance imaging system in accordance with the first variant;

Drawing Description Text (10):
FIG. 8 is a partly-perspective front view showing the structure of a gantry of a magnetic resonance imaging system in accordance with the third embodiment of the present invention;

Drawing Description Text (12):
FIG. 10 is a partly-perspective front view showing the structure of a gantry of a magnetic resonance imaging system in accordance with the fourth embodiment of the present invention;

Drawing Description Text (13):
FIG. 11 is a partly-perspective partial front view showing the structure of a gantry of a magnetic resonance imaging system in accordance with the fifth embodiment of the present invention;

Detailed Description Text (4):
A magnetic resonance imaging system in accordance with the first embodiment will be described in conjunction with FIGS. 1 to 3.

Detailed Description Text (5):
The magnetic resonance imaging system comprises, as shown in FIGS. 1 and 2, a gantry 11 having a diagnostic space in which a patient is inserted and positioned for diagnosis, a patient couch 12 (See FIG. 2) located adjacent to the gantry 11, and a control and processing unit 13 for controlling the operations of the gantry 11 and patient couch 12 and processing a received MR signal. The gantry 11 has a substantially cylindrical diagnostic space S, into which a patient is inserted and positioned, in the internal center bore thereof. The axial direction of the cylindrical diagnostic space S is

defined as a Z-axis direction, and X-axis and Y-axis directions orthogonal to the Z-axis direction are defined as illustrated.

Detailed Description Text (7):
Located in the bore 21br of the magnet 21 is a structure having a gradient coil unit 23 retained in a vacuum closed state. The structure is, as illustrated, composed of an inner cylinder 24 made of a nonmagnetic material and having a given diameter smaller than the diameter of the bore 21br, and vacuum covers 25A and 25B made of a nonmagnetic material for closing the space defined between the magnet 21 and inner cylinder 24 at both ends in the Z-axis direction.

Detailed Description Text (11):
In the closed space CS, the gradient coil unit 23 is placed in non-contact with the defining members. The gradient coil unit 23 is composed of x gradient coils, y gradient coils, and z gradient coils which are windings layered and impregnated on a bobbin, and are shaped lie a cylinder as a whole. The gradient coil unit 23 may be of a non-shielded type or shielded type.

Detailed Description Text (12):
The gradient coil unit 23 is located in the closed space CS and supported above the floor F by support assemblies 40A and 40B, which serve as a supporting means, located at both ends in the Z-axis direction of the magnet. The support assemblies 40A and 40B are each composed of a support member 41 for holding the gradient coil unit 23 at three points in the closed space CS, two rods 42 for supporting the support member 41, and a base 43 on which the rods 42 are resting. Two beams 44 are placed for linking the bases 43 at both ends in the Z-axis direction. The support assemblies 40A and 40B are made preferably of an aluminum material, stainless material, or an alloy of the aluminum or stainless material with lead and/or brass so that the support assemblies will exhibit high rigidity. Thus, vibrations propagated from the gradient coil unit 23 to the support assemblies 40A and 40B can be transmitted to the floor efficiently.

Detailed Description Text (13):
The support members 41 each are a square bar shaped substantially like a bracket, and have a three-point holding structure in which the distal end positions of a support member hold the horizontally side positions of the gradient coil unit 23, and the lower center position of the support member holds the vertically lower position of the gradient coil unit 23.

Detailed Description Text (14):
At the catching positions of the support members 41, the gradient coil unit 23 is supported by setscrews 46a, 46b, and 46c which are structured to be screwed and whose positions can be adjusted with elastic members 45a, 45b, and 45c made of rubber or the like between the support member and setscrews. The first elastic members 45c placed at the vertically lower positions of the gradient coil unit 23 exert a repulsion to support the gradient coil unit 23, and the second elastic members 45a and 45b placed at the horizontally side positions thereof exert a repulsion to support the gradient coil unit 23. By adjusting the degree of screwing the setscrews 46a and 46b for supporting the horizontally side positions of the gradient coil unit 23, the horizontal position of the gradient coil unit can be adjusted. By adjusting the degree of screwing the setscrews 46c for supporting the vertically lower positions of the gradient coil unit, the vertical position of the gradient coil unit can be adjusted. Consequently, the horizontal position and vertical position of the gradient coil unit 23 can be adjusted by adjusting the degrees of screwing the setscrews 46a, 46b, and 46c.

Detailed Description Text (15):
The first elastic members 46c and setscrews 46c for holding the vertically lower positions of the gradient coil unit at both ends in the Z-axis direction thereof bear the load of the gradient coil unit 23. The elastic constant of the first elastic members 45c located immediately under the gradient coil unit is set to a sufficiently larger value than that of the second elastic members 45a and 45b placed at the horizontally side positions The first elastic members 45c located immediately under the gradient coil unit are therefore designed to reduce vibrations stemming from the gradient coil unit 23 while bearing the total load and to reduce solid-borne vibrations of the support assemblies 40A and 40B. The elastic constant of the second elastic members 45a and 45b placed at the vertically lower positions is so small that solid-borne vibrations propagating from the gradient coil unit 23 to the support assemblies 40A and 40B can be reduced reliably.

Detailed Description Text (16):

The supported positions or the positions at which the gradient coil unit 23 is supported by the combinations of the first elastic numbers 45c bearing the total load of the gradient coil unit 23 and the setscrews 46c are not necessarily limited to the illustrated vertically lower positions or lowest positions, but may be lower positions near the vertically lower positions or side positions. The supported positions are shifted from the vertically lower positions to positions in the lateral directions (side positions), the gradient coil unit 23 is supported with shearing stresses proportional to the shift from the vertically lower positions. The elastic constant of the first elastic members 45c should preferably be adjusted accordingly.

Detailed Description Text (17):
Furthermore, the two rods 42 and 43 located at given positions of both ends of each support member have the ability to support each support member 41 in a vertical direction (Y-axis direction). The upper ends of the rods 42 are fitted into holes 41hl bored in the support member 41 and fixed by hexagon nuts 47. The holes 41hl bored in the support member 41 are so-called "fool holes." By adjusting heights and positions at which the hexagon nuts 47 are tightened, the horizontal and vertical positions of the support member can be adjusted. By thus adjusting each support member, the horizontal and vertical positions of the gradient coil unit 23 can be adjusted. The lower ends of the rods 42 are loosely inserted into holes h bored in the bottoms of the side members 30sd of the flanges 30A and 30B, extended downward, and then rigidly coupled to the bases 43 while being screwed up.

Detailed Description Text (19):
The bases 43 are, as shown in FIG. 2, stepped at both ends thereof in the X-axis direction. The bases 43 are rigidly coupled to the floor F by tightening anchor bolts 51 at the positions of the steps. The anchor bolts 51 serve as a coupling means for rigidly coupling the supporting means of the present invention to the installation place (floor). The anchor bolts 51 typical of the coupling means are used to attenuate vibrations propagating from the gradient coil unit 23 through the support assemblies 40A and 40B by utilizing (absorbing) the mass of the floor F which is much heavier than the gradient coil unit 23.

Detailed Description Text (21):
As shown in FIG. 1, an exhaust means for exhausting air from the closed space CS accommodating the gradient coil unit 23 is connected to one vacuum cover 25A. The exhaust means in composed of a vacuum-proof hose 55 linked to a given position of the side member 30sd of the flange 30A, and a vacuum pump 56, which is, for example, of a rotary type, linked to the hose 55. Thus, when the vacuum pump 56 it driven, the closed space CS cm be brought to a vacuum state defined with, for example, 1.01.times.10.sup.3 to 10.sup.8 Pa.

Detailed Description Text (22):
Furthermore, as shown in FIG. 2, a mechanism for supplying power and a cooling medium to the gradient coil unit 23 through the vacuum cover 26B located an the opposite side of the gantry 11 relative to the patient couch 12. The vacuum cover 26B includes, as mentioned previously, the flange 30B and vacuum end plate 31B. A vibration insulation terminal 60 of a vacuum-proof type for preventing a discharge phenomenon is, as illustrated, attached airtightly to a given position of the side member 30sd of the flange 30B. An outer power cable 61 and inner power cable 62 are linked by the terminal 60. The terminal 60 functions as a relay for relaying power from a non-vacuum room to the vacuum space CS. The outer power cable 61 in linked to a gradient power supply (not shown) incorporated in the control and processing unit 13. The inner power cable 62 is placed in the closed space CS that is a vacuum space, and linked to the windings of the gradient coil unit 23. Over the inner power cable 62, a pulsed voltage of, for example, about .+-.2000 V supplied over the outer power cable 61 is supplied to the winding. For the inner power cable 62, vacuum-proof wires that are easily bendable and flexible are used for the purpose of reducing solid propagation of vibrations stemming from the gradient coil unit 23.

Detailed Description Text (23):
A two-port type coupler 64 of a vacuum-proof type is attached airtightly to another given position of the side member 30sd of the flange 30B. The coupler 64 functions as a relay for allowing a cooling medium (for example, water) for cooling the gradient coil unit 23 to go and return between the room and vacuum space CS. Two outer tubes 65 and two inner tubes 66 are linked by the coupler 64, thus forming incoming and outgoing paths. The outer tubes 65 are joined with a cooling medium supply source, for example, a tap. Vacuum-proof tubes having flexibility are used as the inner tubes 66. Therefore, solid propagation of vibrations stemming from the gradient coil unit 23 can be reduced

reliably.

Detailed Description Text (24):
The other ends of the inner tubes 66 are joined with an entry and exit of a cooling tube (not shown) wound, for example, spirally inside the gradient coil unit 23. The cooling medium supplied over one outer tube 65 reaches the cooling tube through one inner tube 66, circulates through the cooling tube, and then returns to the cooling medium supply source through the other inner tube 66 and the other outer tube 65. Heat dissipated by driving the gradient coil unit 23 is therefore removed forcibly.

Detailed Description Text (29):
The vacuum pump 56 is actuated in order to exhaust the closed space CS surrounding the gradient coil unit 23. A vacuum state defined with a given value is thus created in the closed space CS. Moreover, a current is supplied from the static power supply to the magnet 21, and a static magnetic field is produced in the diagnostic space S including a scanning aréa. In this state, the patient lying down on the couchtop 67t is inserted into the diagnostic space S. At this time, the couchtop 67t is guided and supported by the couchtop rail 68 that is a unique constituent feature of this embodiment. Shimming is then carried out if necessary. After necessary preparations such as placement of a reception coil and positioning of a slice plane have been made, diagnosis is started. Specifically, the control and processing unit 13 issues control commands to the components of the gantry according to a desired pulse sequence, and receives an MR signal produced in the patient body. Based on the MR signal, image data is reconstructed.

Detailed Description Text (30):
In the driven state based on a pulse sequence, a pulsating current that rises or falls abruptly is applied to the gradient coil unit 23. In particular, when the pulse sequence is a pulse sequence for fast imaging, the pulsating current is quickly reversed in polarity. Since the gradient coil unit 23 is placed in the static magnetic field, every time the pulsating current makes a state transition quickly, an electromagnetic force is generated. The electromagnetic force causes mechanical deflections, that is, vibrations. The magnitude of the electromagnetic force varies in a complex manner depending on the positions of the x coils, y coils, and z coils. The gradient coil unit 23 therefore normally vibrates in a complex mode.

Detailed Description Text (31):
Even when the gradient coil unit 23 vibrates, since, in this embodiment, the gradient coil unit 23 is located in the vacuum space, it will not cause the air surrounding the gradient coil unit to vibrate. In other words, aerial propagation of vibrations indicated with arrows A1 in FIG. 3 is eliminated or reliably suppressed. Vibrations propagating outside can be markedly reduced.

Detailed Description Text (32):
By contrast, vibrations made by the gradient coil unit 23 are propagated by conduction via solids through the support assemblies 40A and 40B and liable to leak out. However, since various measures for absorbing or suppressing solid-borne vibrations are taken as mentioned previously, leaking vibrations become very weak.

Detailed Description Text (33):
Since the elastic members 45a, 45b, and 45c for supporting the gradient coil unit 23 on the sides and bottom of the gradient coil unit 23 are located at both ends in the Z-axis direction of the gradient coil unit 23, vibrations are absorbed as greatly as possible and propagation of vibrations to the support assemblies 40A and 40B is suppressed. Vibrations that cannot be removed by the elastic members propagate to the support assemblies 40A and 40B.

Detailed Description Text (36):
Furthermore, almost all the outer surfaces of the support assemblies 40A and 40B except parts of the bases 43 are encircled with the vacuum space (closed space CS). Like the gradient coil unit 23, therefore, airborne vibrations that leak out are quite limited.

Detailed Description Text (38):
(1) aerial propagation of vibrations (that is, noises) stemming from the gradient coil unit itself that vibrates greatly and the support assemblies 40A and 40B can be blocked greatly owing to the vacuum space.

Detailed Description Text (39):
(2) the vibrations can be eliminated as greatly as possible by the elastic members

interposed between the support assemblies 40A and 40B and the gradient coil unit 23,

Detailed Description Text (41):
(4) almost all the vibrations propagating to the magnet and couchtop rail can be eliminated owing to the combined effect of individual support of the gradient coil unit 23, magnet 21, and couchtop rail 68, flexible hold of the power cable and cooling tube, and suppression of vibrations by the floor F and vacuum bellows 50, objects that may be vibrated can be reduced in number, and eventually noises can be minimized. Since the solid-propagation path is extended to the floor, an effect of vibration reduction can be expected in the course of propagation Assuming, that a driven state is the same, unlike various gantry structures disclosed in patent publications or a gantry structure in which a gradient coil unit and a magnet for generating a static magnetic field are supported mechanically separately, even when a pulse sequence for fast imaging is used, vibrations and noises derived from vibrations made by the gradient coil unit itself can be minimized drastically. Consequently, a sense of unease or discomfort to be given to a patient because of the noises (vibrations) can be nullified successfully.

Detailed Description Text (42):
In additions since facilities for adjusting the position of the center axis of the diagnostic space S and for adjusting the position of the gradient coil unit 23 are, as mentioned previously, placed at various positions, the gantry structure of this embodiment has the merit of easy assembly, maintenance, and inspection.

Detailed Description Text (43):
According to the present inventions a structure in which no vacuum space is created around the outer circumferences of the gradient coil unit and support assemblies but, like the aforesaid gantry structure, the magnet 2 and gradient coil unit 23 are supported separately and the support assemblies 40A and 40B are rigidly coupled to the floor by the anchor bolts 51 can be adopted. Compared with a known structure in which a magnet and gradient coil unit are merely supported separately, this structure will prove effective in reducing overall noises because the operation of vibration attenuation due to the mass affect of the floor can be actively utilized.

Detailed Description Text (44):
In the aforesaid gantry structure, an elastic member may me interposed between each base 43 and the floor F in order to absorb vibrations propagating through solid-state members more efficiently. In this case, the anchor bolts 51 may or may not be employed. Even when the anchor bolts 51 are not employed, a solid-propagation path along which vibrations propagate from the gradient coil unit 23 to the magnet 2 or inner cylinder 24 is detoured to be routed to the floor via the support assemblies 40A and 40B, or made longer. The vibrations reaching the magnet 21 or inner cylinder 24 are therefore weakened. Moreover, the vibrations or noises can be reduced owing to an effect of vibration attenuation exerted in the course of the routing.

Detailed Description Text (45):
In the aforesaid structure, the terminal for the power cables and/or the coupler for the cooling tube, which work as a relay, may be attached airtightly to part of a support assembly, for example, the base thereof but not to the aforesaid vacuum cover. In this case, the power cables and cooling tube are routed to the gradient coil unit through a passage linking a base, rod, and support member.

Detailed Description Text (46):
Furthermore, an a cooling structure for cooling the gradient coil unit 23, numerous cooling pipes may be juxtaposed, wound spirally, and hardened cylindrically using a resin.

Detailed Description Text (48):
A magnetic resonance imaging system in accordance with the second embodiment will be described in conjunction with FIG. 4 and 5. In the description below, the same reference numerals will be assigned to components identical or similar to those in the first embodiment. The description of the components will be omitted (the same applies to subsequent embodiments).

Detailed Description Text (49):
An object of the magnetic resonance imaging system of this embodiment is to achieve a marked reduction of noises and to simplify a structure for reducing noises ax greatly as possible.

Detailed Description Text (50):

FIGS. 4 and 5 show the structure of the gantry 11 alone of the magnetic resonance imaging system. The gantry 11 has substantially the same structure as the one in the first embodiment but is different in the structure of a vacuum cover.

Detailed Description Text (52):
The vacuum end plates 72A and 72B, base members 71bt and side members 71sd are longer in the direction of the skirts of the vacuum covers (vertically or in the Y-axis direction) than the corresponding members in the first embodiment. The ends of these members are bent inward or the members have bent ends, and the ends arm fixed airtightly to the bases 43 with vacuum sealing members between the members and bases. Thus, the closed space CS accommodating the upper parts of the support assemblies 40A and 40B above the bases 43 thereof and the gradient coil unit 23 can be sealed. In this embodiment, the vacuum bellows linking the vacuum covers and support assemblies, which are employed in the first embodiment are unnecessary.

Detailed Description Text (54):
Although solid-borne vibrations propagating from the support assemblies 40A and 40B to the vacuum covers 70A and 70B remain intact, absorption works effectively owing to an effect of vibration absorption exerted by the elastic members of the support assemblies 40A and 40B and a mass effect exerted by the floor F to which the support assemblies 40A and 40B are rigidly coupled. Components that vibrate especially greatly, such as, the gradient coil unit 23 and support assemblies 40A and 40B are thus prevented from vibrating as a top priority. Noises derived from the vibrations made by the gradient coil unit 23 can be reduced more greatly than they are in the known systems. Moreover, the configuration of the system can be simplified because the vacuum bellows can be excluded.

Detailed Description Text (56):
A variant of the second embodiment will be described in conjunction with FIGS. 6 and 7. A gantry of a magnetic resonance imaging system of this variant has a supporting means shared by a gradient coil unit and a magnet for generating a static magnetic field.

Detailed Description Text (57):
As shown in FIGS. 6 and 7, a support assembly 40A is included for supporting the gradient coil unit 23 (the same support assembly is installed at the opposite and in the Z-axis direction of the gradient coil unit 23 in the same manner). The support assembly 40A is placed on two rails 75 via elastic members 74 respectively. The two rails 75 are fixed to the floor F. At this time, preferably, the rails 75 are rigidly coupled to the floor F. The two rails 75 are also supporting the magnet 21 for generating a static magnetic field.

Detailed Description Text (59):
Owing to the foregoing structure, a solid-propagation path along which vibrations propagate from the gradient coil unit 23 to the magnet 21 is routed to the floor once due to the placement of the support assembly 40A, and is therefor detoured farther than that in a known system. An effect of noise insulation exerted by the vacuum space CS as well as an effect of vibration attenuation exerted by the detoured solid-propagation path are made available. Noises can therefore be reduced more efficiently than those in the known system. In a known system in which a gradient coil unit is supported by the inner circumferential surface or flank of a magnet for generating a static magnetic field, the gradient coil unit 23 is linked to the magnet 21 by a very short path. Vibrations made by the gradient coil unit arm solid-borne nearly directly to the magnet. This poses a problem that vibrations made by the magnet are also added to a noise source. However, despite the employment of a gantry whose supporting structure is relatively simplified as mentioned above, a noiseless magnetic resonance imaging system free from the problem can be provided. When the rails are rigidly coupled to the floor F, as mentioned above, attenuation of vibrations due to the mass effect of the floor works in combination. The noiselessness is further upgraded.

Detailed Description Text (62):
A magnetic resonance imaging system of the third embodiment will be described in conjunction with FIGS. 8 and 9.

Detailed Description Text (63):
An object of the magnetic resonance imaging system of this embodiment is to provide a greater effect of noise reduction than that provided by the magnetic resonance imaging system of the first embodiment. For accomplishing the object, the gantry 11 shown in FIGS. 8 and 9 includes, in addition to the same components as those in the first embodiment, another noise reduction mechanism.

Detailed Description Text (66):
As mentioned above, in addition to the components in the first embodiment, a mechanism is included for more finely suppressing propagation of vibrations in the air and propagation of vibrations to a magnet for generating a static magnetic field. Induction of noises by drive of a gradient coil unit can be suppressed more reliably than that in the first embodiment.

Detailed Description Text (70):
A magnetic resonance imaging system of the fourth embodiment will be described in conjunction with FIG. 10.

Detailed Description Text (71):
In the gantry 11 of the magnetic resonance imaging system, as illustrated, a vacuum cover 70A composed of a flange and vacuum end plate has a skirt thereof extended and has the extended end of the skirt coupled airtightly to components located near the lower sides of the base 43 of the support assembly 40A. A vacuum cover located at the other and in the Z-axis direction of the gantry has the same structure.

Detailed Description Text (72):
The closed space CS exhausted to a vacuum accommodates not only the gradient coil unit 23 but also the support assemblies 40A and 40B at both ends of the gradient coil unit. This obviates the necessity of the aforesaid vacuum bellows. Parts that vibrate most strongly can all be accommodated in the vacuum space, whereby a great effect of noise insulation can be exerted. At the same time, an effect of vibration absorption resulting from rigid coupling of the support assemblies to the floor can be exerted. Even from this viewpoint, a magnetic resonance imaging system excellent in noiselessness can be provided.

Detailed Description Text (74):
A magnetic resonance imaging system of the fifth embodiment will be described in conjunction with FIG. 11. This embodiment is intended to fulfill the aforesaid coupling mechanism for coupling the vacuum covers to the inner cylinder. FIG. 11 shows such a coupling mechanism alone located at one end in the Z-axis direction of the gantry.

Detailed Description Text (75):
As shown in FIG. 11 the gantry of the magnetic resonance imaging system in accordance with the present invention includes a vacuum cover 90 for closing the gap between the inner circumferential surface 21in of the magnet 21 for generating a static magnetic field and the inner cylinder 24. The vacuum cover 90 includes a flange 91 and vacuum end plate 92. The flange 91 is composed of a base member 91bt to be airtightly attached to the flank 21sd of the magnet 21 and a side member 91sd united with the base member. The section in the Z-axis direction of the flange 91 is shaped like a letter L. The base member 91bt is airtightly attached to the flank 21sd by a setscrew 94 with a vacuum sealing member 93 between them.

Detailed Description Text (78):
The elastic member 100b bears almost the whole weight of the vacuum cover 90 that is, almost all the weights of components and parts linking the magnet 21 and the inner cylinder 24 owing to a shearing stress. Since the elastic member 100b is included, solid vibrations to be propagated from the magnet 21 to the cylinder 24 can be reduced. Moreover, since almost the whole weight of the inner cylinder 24 is borne by the inner-cylinder suspending mechanism 100, the elastic constant of the vacuum sealing member 97 can be made smaller. Eventually, solid propagation of vibrations from the magnet 21 through the vacuum cover to the inner cylinder 24 can be reduced. Moreover, in the case of this structure, the elastic constant of the elastic member 100b for supporting the inner cylinder is much smaller than that of the first elastic member 45c bearing the weight of the gradient coil unit shown in FIG. 1 that has been referred to previously. In other words, solid-borne vibrations passing through the inner-cylinder suspending mechanism 100 can be greatly limited.

Detailed Description Text (79):
As mentioned above, owing to the structure for not propagating vibrations from the magnet 21 to the inner cylinder 24 as greatly as possible, not only vibrations caused by vibrations stemming from the gradient coil unit 23 but also vibrations induced by drive of the magnet 21 itself can be suppressed. Consequently, vibrations made by the inner cylinder 24 that is structurally hard to affix a noise absorbing material or the like and is therefore bared can be suppressed, and occurrence of noises can be prevented.

Detailed Description Text (81):
A variant will be described in conjunction with FIG. 12. FIG. 12 shows an example of a power cable led into the gradient coil unit 23. A relay terminal 110 having the ability to insulate vibrations owing to inclusion of an elastic member 110a having flexibility and the ability to withstand a vacuum is attached to the flange 30B of the vacuum cover 25B. A power cable 111 is led into the vacuum space CS via the relay terminal 110. The power cable 111 is structured as an inner power cable 111a, which is made by coating a bendable conductor (for example, a mesh conductor) with an electrically insulating material, at least in the vacuum space CS.

Detailed Description Text (82):
The inner power cable 111a is linked to the gradient coil unit 23. Vibrations propagating from the gradient coil unit 23 to the vacuum cover 25B over the inner power cable 111a are therefore reduced drastically. Furthermore, the elastic member 110a of the relay terminal 110 further facilitates suppression of vibration propagation. Moreover, since the inner cable 111a has the conductor thereof coated with an electrically insulating material, a discharge phenomenon can be prevented reliably.

Detailed Description Text (84):
Another variant will be described in conjunction with FIG. 13. FIG. 13 shows an example of cooling tubes led into the gradient coil unit 23. A two-port coupler 113 having the ability to insulate vibrations owing to inclusion of an elastic member 113a having flexibility and the ability to withstand a vacuum is attached to the flange 30B of the vacuum cover 25B. Tubes 114 and 115 go and return between the vacuum space CS and external world by way of the coupler 113. Vibrations propagating from the gradient coil unit 23 to the vacuum cover 25B over the tubes 114 and 115 are reduced owing to the elastic member 113a of the coupler 113.

Detailed Description Text (86):
FIG. 14 shows yet another variant. The illustrated gantry 11 has the same components as the one shown in FIG. 1. However, instead of the floor F, a ceiling C is used as an installation place on which the support assemblies 40A and 40B for supporting the gradient coil unit 23 are placed. Specifically, the magnet 21 for generating a static magnetic field is installed on the floor F in the same manner as that described previously. However, the gradient coil unit 23 is suspended from the ceiling C via the support assemblies 40A and 40B. The ceiling C is designed to exhibit high rigidity. The support assemblies 40A and 40B are rigidly coupled to the ceiling C using the anchor bolts 51.

Detailed Description Text (87):
In this case, therefore, the operation of vibration attenuation derived from a mass effect exerted by the ceiling C can be obtained. Moreover, since the floor F (on which the magnet is installed) and the ceiling C (from which the gradient coil unit is suspended) which are installation places hardly affected by vibrations are separated from each other, solid propagation of vibrations on the installation places can be blocked nearly perfectly. Eventually, a noiseless gantry having noises reduced greatly can be provided.

Detailed Description Text (88):
A described so far, a gantry has a structure including a means for retaining a magnetic field gradient generating means in a mechanically uncoupled or substantially uncoupled state relative to a static magnetic field generating means, and supporting the magnetic field gradient generating means above an installation place, and a means for defining a closed space around at least the magnetic field gradient generating means, and bringing the closed space to a vacuum state. This results in a noiseless magnetic resonance imaging system in which solid-borne vibrations propagating from a gradient coil unit through the magnetic field gradient supporting means to a magnet are reduced markedly, airborne vibrations stemming from the gradient coil unit can be cut off, and noises (vibrations) occurring in the whole gantry are suppressed to a very low level.

Detailed Description Text (89):
According to another aspect, a gantry has a structure including a means for retaining a magnetic field gradient generating means and static magnetic field generating means in a mechanically uncoupled or substantially uncoupled state and supporting both the magnetic field generating means separately above an installation place, and a means for rigidly coupling these means to the installation place. Vibration attenuation due to a mass effect exerted by the installation place such as a floor can be utilized actively, solid-borne vibrations propagating from the gradient coil unit to the magnetic field

gradient supporting means can be reduced markedly, and noises (vibrations) occurring in the whole gantry can be suppressed successfully.

CLAIMS:

1. A magnetic resonance imaging system having a gantry comprising:

static field generating means for generating a static magnetic field in a scanning region defined in a diagnostic space into which an object to be imaged is inserted;

gradient generating means for generating a magnetic field gradient in the scanning region;

supporting means for supporting the gradient generating means in a condition where the weight of the gradient generating means is substantially not applied to the static field generating means; and

vacuum space creating means for not only defining a closed space located around at least the gradient generating means but also bringing the closed space into a vacuum state.

2. The system of claim 1, wherein the static field generating means comprises a magnet not only generating the static magnetic field but also having the diagnostic space and the gradient generating means comprises gradient coils generating the magnetic field gradient.

3. The system of claim 2, wherein the vacuum space creating means comprises a space-defining element for defining the closed space located around at least an assembly of the gradient coils, the space-defining element being rigidly uncoupled with the gradient generating means.

6. A magnetic resonance imaging system having a gantry comprising:

static field generating means for generating a static magnetic field in a scanning area in a diagnostic space;

gradient generating means for generating a magnetic field gradient in the scanning area;

supporting means for retaining the gradient generating means in a substantially-uncoupled state relative to the static field generating means and supporting the gradient generating means on an installation place; and

vacuum space creating means for defining a closed space around at least the gradient generating means and bringing the closed space to a vacuum state,

whereby noises derived from drive of the gradient generating means are suppressed;

wherein the static field generating means comprises a magnet generating the static magnetic field and the gradient generating means comprises gradient coils generating the magnetic field gradient;

wherein the vacuum space creating means comprises a space-defining element for defining the closed space around at least the gradient coils, the space-defining element being rigidly uncoupled with the gradient generating means; and

wherein the vacuum space creating means comprises pumping means for exhausting gas from the closed space.

7. The system of claim 6, wherein the magnet has axial and radial directions and the assembly of the gradient coils are composed of x-coils, y-coils, and z-coils generating gradients serving as the magnetic field gradient in a mutually-orthogonal X-, Y-, Z-directions set with respect to the gantry.

8. The system of claim 7, wherein the supporting means comprises a single pair of supporting elements individually supporting the gradient coils at both sides of the magnet in the axial direction thereof, wherein each supporting element comprises a supporting member retaining the gradient coils, a rod member supporting the supporting member, and a base member supporting the rod member erected on the installation place.

9. A magnetic resonance imaging system having a gantry comprising:

static field generating means for generating a static magnetic field in a scanning area in a diagnostic space;

gradient generating means for generating a magnetic field gradient in the scanning area;

supporting means for retaining the gradient generating means in a substantially-uncoupled state relative to the static field generating means and supporting the gradient generating means on an installation place; and

vacuum space creating means for defining a closed space around at least the gradient generating means and bringing the closed space to a vacuum state,

whereby noises derived from drive of the gradient generating means are suppressed;

wherein the static field generating means comprises a magnet generating the static magnetic field and the gradient generating means comprises gradient coils generating the magnetic field gradient;

wherein the vacuum space creating means comprises a space-defining element for defining the closed space around at least the gradient coils, the space-defining element being rigidly uncoupled with the gradient generating means; and

means for rigidly coupling the supporting means with an object on which the system is installed at the installation place.

10. A magnetic resonance imaging system having a gantry comprising:

static field generating means for generating a static magnetic field in a scanning area in a diagnostic space;

gradient generating means for generating a magnetic field gradient in the scanning area;

supporting means for retaining the gradient generating means in a substantially-uncoupled state relative to the static field generating means and supporting the gradient generating means on an installation place; and

vacuum space creating means for defining a closed space around at least the gradient generating means and bringing the closed space to a vacuum state,

whereby noises derived from drive of the gradient generating means are suppressed;

wherein the supporting means is constructed such that the supporting means supports the gradient generating means in a state where weight of the gradient generating means is substantially not applied to the static field generating means.

11. A magnetic resonance imaging system having a gantry comprising:

static field generating means for generating a static magnetic field in a scanning area in a diagnostic space;

gradient generating means for generating a magnetic field gradient in the scanning area;

supporting means for retaining the gradient generating means in a substantially-uncoupled state relative to the static field generating means and supporting the gradient generating means on an installation place; and

vacuum space creating means for defining a closed space around at least the gradient generating means and bringing the closed space to a vacuum state,

whereby noises derived from drive of the gradient generating means are suppressed;

wherein the supporting means is constructed so as to support the gradient generating means differently in configuration of physical structures from the static field

generating means.

12. A magnetic resonance imaging system having a gantry comprising:

static field generating means for generating a static magnetic field in a scanning region defined in a diagnostic space into which an object to be imaged is inserted;

first supporting means for supporting the static field generating means at a position on an installation place of the system;

gradient generating means for generating a magnetic field gradient in the scanning region; and

second supporting means for supporting the gradient generating means at another position different from the supported position of the static field generating means on the installation place in a condition where the weight of the gradient generating means is substantially not applied to the static field generating means.

14. The system of claim 13, wherein the static field generating means comprises a magnet generating the static magnetic field and having axial and radial directions and the gradient generating means comprises gradient coils composed of x-coils, y-coils, and z-coils generating gradients serving as the magnetic field gradient in a mutually-orthogonal X-, Y-, Z-directions set with respect to the gantry.

15. The system of claim 13, comprising a space-defining element for defining a closed space located around at least the gradient coils and pumping means for exhausting gas from the closed space.

16. The system of claim 15, wherein the second supporting means comprises a single pair of supporting elements individually supporting the gradient coils at both sides of the magnet in the axial direction thereof, wherein each supporting element comprises a supporting member retaining the gradient coils, a rod member supporting the supporting member, and base member supporting the rod member at the installation place.

18. A magnetic resonance imaging system having a gantry comprising:

static field generating means for generating a static magnetic field in a scanning area in a diagnostic space;

first supporting means for supporting the static field generating means at a position on an installation place;

gradient generating means for generating a magnetic field gradient in the scanning area;

second supporting means for retaining the gradient generating means in a substantially uncoupled state with respect to the static field generating means and supporting the gradient generating means at another position different from the supporting position of the static field generating means on the installation place; and

coupling means for rigidly coupling the second supporting means to the installation place,

whereby noises derived from drive of the gradient generating means are suppressed;

wherein the static field generating means comprises a magnet generating the static magnetic field and having an axial and radial directions and the gradient generating means comprises gradient coils composed of x-coils, y-coils, and z-coils generating gradients as the magnetic field gradient in an X-, Y-, Z-directions set in the gantry;

a space-defining element for defining a closed space around at least the gradient coils and pumping means for exhausting gas from the closed space;

wherein the second supporting means comprises a single pair of supporting elements individually supporting the gradient coils at both sides of the magnet in the axial direction thereof, wherein each supporting element comprises a supporting member retaining the gradient coils, a rod member supporting the supporting member, and a base member supporting the rod member on the installation place; and

wherein the space-defining element has a configuration including at least part of the members of the second supporting means.

20. The system of claim 19, wherein the space-defining element has an inner cylinder defining part of the diagnostic space by positioning the inner cylinder so as to be positioned in the order of the inner cylinder, the gradient coils, and the magnet in the radial direction of the gantry, a cover element airtightly covering an aperture formed between the cylinder and the magnet, and a sealing element airtightly sealing a gap formed between the cover element and each supporting element.

30. The system of claim 29, wherein the second supporting means comprises another elastic element intervening between the supporting member and a unit incorporating the gradient coils and supporting weight of the unit, another elastic element being greater in elastic constant than the elastic element.

31. The system of claim 20, wherein the cover element is provided with at least one of relay members relaying a power line and a cooling tube airtightly passed through the cover element, the power cable supplying current to the gradient coils and the cooling tube supplying a cooling medium to a unit incorporating the gradient coils therein.

32. The system of claim 31, wherein the relay member has a vibration insulation terminal having flexibility and vacuum-proof performance.

33. The system of claim 31, wherein the power cable is formed into a flexible cable in the vacuum space, the flexible cable being covered by an electric insulation material.

35. A magnetic resonance imaging system having a gantry comprising:

static field generating means for generating a static magnetic field in a scanning area in a diagnostic space;

first supporting means for supporting the static field generating means at a position on an installation place;

gradient generating means for generating a magnetic field gradient in the scanning area;

second supporting means for retaining the gradient generating means in a substantially uncoupled state with respect to the static field generating means and supporting the gradient generating means at another position different from the supporting position of the static field generating means on the installation place; and

coupling means for rigidly coupling the second supporting means to the installation place,

whereby noises derived from drive of the gradient generating means are suppressed;

wherein the static field generating means comprises a magnet generating the static magnetic field and having an axial and radial directions and the gradient generating means comprises gradient coils composed of x-coils, y-coils, and z-coils generating gradients as the magnetic field gradient in an X-, Y-, Z-directions set in the gantry;

wherein the coupling means comprises an anchoring element rigidly coupling the second supporting means to a rigid floor formed as the installation place; and

wherein the second supporting means comprises a single pair of supporting elements individually supporting the gradient coils at both sides of the magnet in the axial direction thereof, wherein each supporting element comprises a base member paced on the installation place, both the base members positioned at both the sides of the magnet in the axial direction thereof being coupled with each other by a coupling element having high rigidity.

36. A magnetic resonance imaging system having a gantry comprising:

static field generating means for generating a static magnetic field in a scanning area in a diagnostic space;

first supporting means for supporting the static field generating means at a position on an installation place;

gradient generating means for generating a magnetic field gradient in the scanning area;

second supporting means for retaining the gradient generating means in a substantially uncoupled state with respect to the static field generating means and supporting the gradient generating means at another position different from the supporting position of the static field generating means on the installation place; and

coupling means for rigidly coupling the second supporting means to the installation place,

whereby noises derived from drive of the gradient generating means are suppressed;

wherein the static field generating means comprises a magnet generating the static magnetic field and having an axial and radial directions and the gradient generating means comprises gradient coils composed of x-coils, y-coils, and z-coils generating gradients as the magnetic field gradient in an X-, Y-, Z-directions set in the gantry;

wherein the coupling means comprises an anchoring element rigidly coupling the second supporting means to a rigid floor formed as the installation place; and

wherein the second supporting means comprises a single pair of supporting elements individually supporting the gradient coils at both sides of the magnet in the axial direction thereof, wherein each supporting element comprises a position adjusting element whose spatial position is adjustable in a horizontal and vertical direction, thereby spatial positions of the gradient coils being adjustable in the horizontal and vertical positions.

37. The system of claim 36, wherein each supporting element is provided with at least one of relay members relaying a power line and a cooling tube airtightly passed through the cover element, the power cable supplying current to the gradient coils and the cooling tube supplying a cooling medium to a unit incorporating the gradient coils therein.

38. A magnetic resonance imaging system having a gantry comprising:

static field generating means for generating a static magnetic field in a scanning area in a diagnostic space;

first supporting means for supporting the static field generating means at a position on an installation place;

gradient generating means for generating a magnetic field gradient in the scanning area;

second supporting means for retaining the gradient generating means in a substantially uncoupled state with respect to the static field generating means and supporting the gradient generating means at another position different from the supporting position of the static field generating means on the installation place; and

coupling means for rigidly coupling the second supporting means to the installation place,

whereby noises derived from drive of the gradient generating means are suppressed;

wherein the static field generating means comprises a magnet generating the static magnetic field and having an axial and radial directions and the gradient generating means comprises gradient coils composed of x-coils, y-coils and z-coils generating gradients as the magnetic field gradient in an X-, Y-, Z-directions set in the gantry;

wherein the coupling, means comprises an anchoring element rigidly coupling the second supporting means to a rigid floor formed as the installation place; and wherein the second supporting means comprises a single pair of supporting elements individually supporting the gradient coils at both sides of the magnet in the axial direction thereof, wherein each supporting means comprises a supporting member retaining an approximately cylindrical unit incorporating the gradient coils therein, and a first elastic member intervening between the supporting member and the unit of the gradient coils and being weighted by weight of the unit.

41. The system of claim 38, wherein each supporting element comprises a lateral position adjusting member having a second elastic member intervening between the supporting member and the unit of the gradient coils and adjusting a lateral directional position of the unit.

44. A magnetic resonance imaging system having a gantry comprising:

static field generating means for generating a static magnetic field in a scanning area in a diagnostic space;

first supporting means for supporting the static field generating means at a position on an installation place;

gradient generating means for generating a magnetic field gradient in the scanning area;

second supporting means for retaining the gradient generating means in a substantially uncoupled state with respect to the static field generating means and supporting the gradient generating means at another position different from the supporting position of the static field generating means on the installation place; and

coupling means for rigidly coupling the second supporting means to the installation place,

whereby noises derived from drive of the gradient generating means are suppressed;

wherein the static field generating means comprises a magnet generating the static magnetic field and having an axial and radial directions and the gradient generating means comprises gradient coils composed of x-coils, y-coils, and z-coils generating gradients as the magnetic field gradient in an X-, Y-, Z-directions set in the gantry;

a space-defining element for defining a closed space around at least the gradient coils and pumping means for exhausting gas from the closed space;

wherein the second supporting means comprises a single pair of supporting elements individually supporting the gradient coils at both sides of the magnet in the axial direction thereof, wherein each supporting element comprises a supporting member retaining the gradient coils, a rod member supporting the supporting member, and a base member supporting the rod member on the installation place; and

a patient couch having a tabletop, on which a patient to be diagnosed is laid, slidably inserted into the diagnostic space, and a rail element slidably supporting and guiding the tabletop in the diagnostic space, wherein the rail element and the gantry are disposed on the installation place in with no contact with each other.

45. An MRI system gantry having magnetic gradient coils mounted and supported separately and independently of a static polarizing magnetic field generator.

46. An MRI system gantry as in claim 45 further comprising a vacuum-containing housing disposed about said magnetic gradient coils.

47. An MRI system gantry having magnetic gradient coils mechanically coupled to independently transfer vibrational motion to a larger mass in the vicinity of its installation that is not part of the gantry.

48. An MRI system gantry as in claim 47 wherein said larger mass is part of a building structure at an installation site which also supports the weight of said magnetic gradient coils.

49. An MRI system gantry as in claim 48 further comprising a vacuum-containing housing disposed about said magnetic gradient coils.